MySQL Workbench

Abstract

This is the MySQL™ Workbench Reference Manual. It documents the MySQL Workbench Community and MySQL Workbench commercial editions 6.3 through 6.3.5.

If you have not yet installed MySQL Workbench Community please download your free copy from the download site. MySQL Workbench Community is available for Windows, OS X, and Linux.

For notes detailing the changes in each release, see the MySQL Workbench Release Notes.

For legal information, see the Legal Notices.

For help with using MySQL, please visit either the MySQL Forums or MySQL Mailing Lists, where you can discuss your issues with other MySQL users.

For additional documentation on MySQL products, including translations of the documentation into other languages, and downloadable versions in variety of formats, including HTML and PDF formats, see the MySQL Documentation Library.

Document generated on: 2015-12-13 (revision: 45868)

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Preface and Legal Notices

This is the User Manual for the MySQL Workbench.

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Chapter 1 General Information

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This chapter provides general information about MySQL Workbench and how it has changed.

MySQL Workbench is a graphical tool for working with MySQL Servers and databases. MySQL Workbench fully supports MySQL Server versions 5.1 and above. It is also compatible with MySQL Server 5.0, but not every feature of 5.0 may be supported. It does not support MySQL Server versions 4.x.

MySQL Workbench functionality covers five main topics:

- **SQL Development**: Enables you to create and manage connections to database servers. Along with enabling you to configure connection parameters, MySQL Workbench provides the capability to execute SQL queries on the database connections using the built-in SQL Editor.
- **Data Modeling (Design)**: Enables you to create models of your database schema graphically, reverse and forward engineer between a schema and a live database, and edit all aspects of your database using the comprehensive Table Editor. The Table Editor provides easy-to-use facilities for editing Tables, Columns, Indexes, Triggers, Partitioning, Options, Inserts and Privileges, Routines and Views.
- **Server Administration**: Enables you to administer MySQL server instances by administering users, performing backup and recovery, inspecting audit data, viewing database health, and monitoring the MySQL server performance.
- **Data Migration**: Allows you to migrate from Microsoft SQL Server, Microsoft Access, Sybase ASE, SQLite, SQL Anywhere, PostreSQL, and other RDBMS tables, objects and data to MySQL. Migration also supports migrating from earlier versions of MySQL to the latest releases.
- **MySQL Enterprise Support**: Support for Enterprise products such as MySQL Enterprise Backup and MySQL Audit.

MySQL Workbench is available in two editions, the Community Edition and the Commercial Edition. The Community Edition is available free of charge. The Commercial Edition provides additional Enterprise features, such as access to MySQL Enterprise Backup and MySQL Audit, at low cost. For a complete comparison, see http://www.mysql.com/products/workbench/features.html

For notes detailing the changes in each release, see the MySQL Workbench Release Notes.

1.1 What Is New in MySQL Workbench 6

This section summarizes how the MySQL Workbench 6 series progressed with each minor release.

For notes detailing the changes in each point release, see the MySQL Workbench Release Notes.

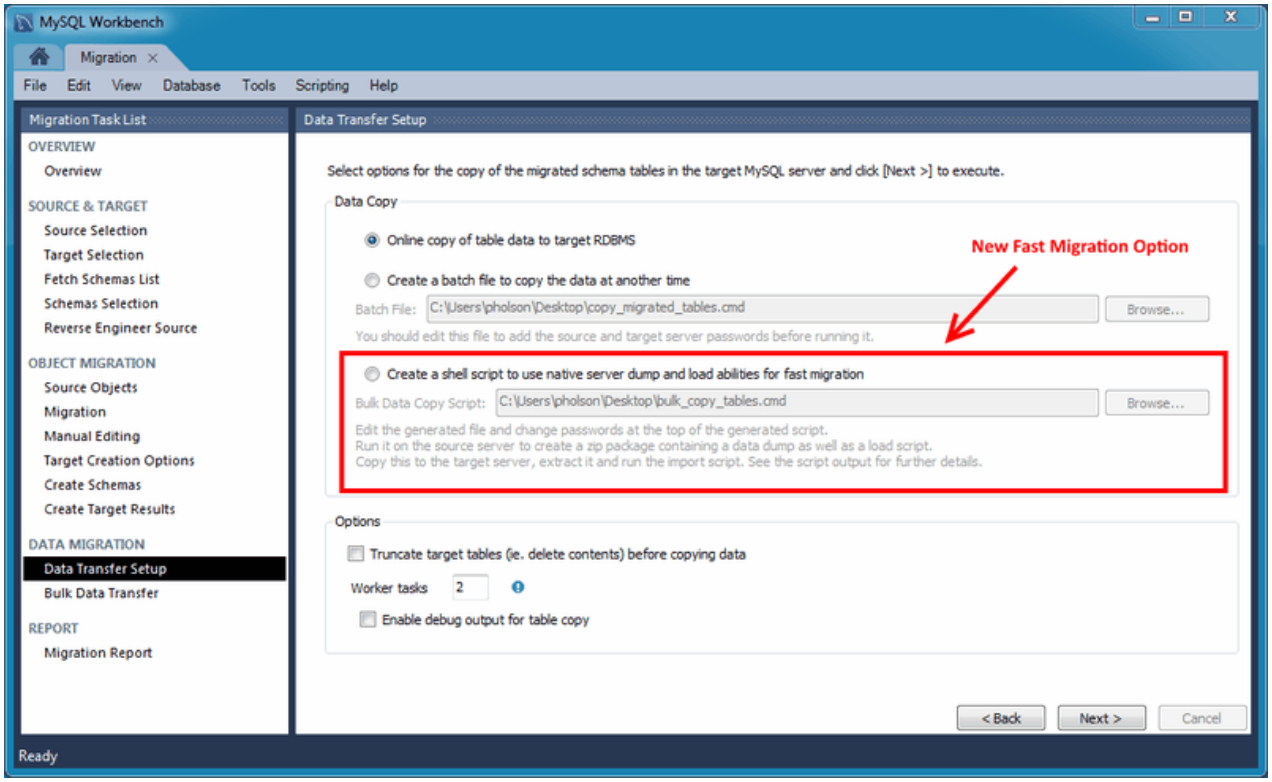
1.1.1 New in MySQL Workbench 6.3

This section summarizes many of the new features added to MySQL Workbench 6.3.x, in relation to MySQL Workbench 6.2.x;.

Fast Data Migration

A new "fast migration" option was added to the migration wizard. This is another way to transfer data from one MySQL server to another while performing a migration, and it complements the existing solutions. The premise is to use a generated script on the source server to create a dump that you move to the target machine to perform the import there. This avoids the need to traffic all data through MySQL Workbench, or to have a permanent network connection between the servers. Instead, the dump and restore is performed at maximum speed by using the LOAD DATA call for the MySQL import. The migration wizard automatically creates all necessary scripts for all supported platforms and servers. The generated script creates a self-contained Zip file that must be copied to the target server. You unzip it and execute the provided script to perform the data import.

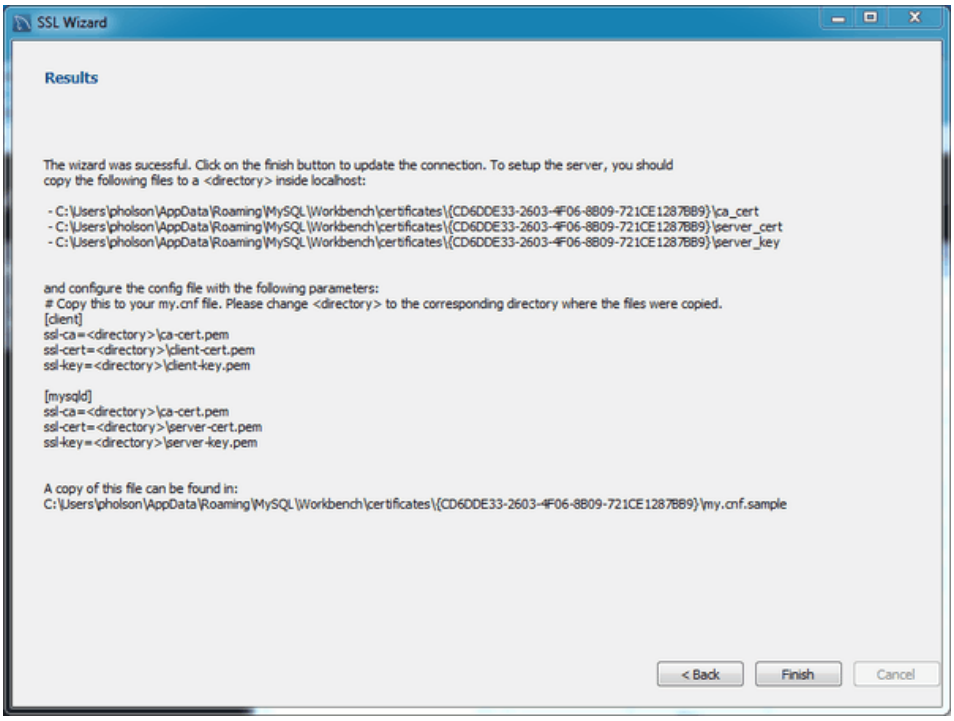
Figure 1.1 Data Transfer Setup: New Fast Migration Option


MySQL Workbench
Migration
File Edit View Database Tools Scripting Help
Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemas List
Schemas Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Data Transfer Setup
Select options for the copy of the migrated schema tables in the target MySQL server and click [Next >] to execute.
Data Copy
Online copy of table data to target RDBMS
Create a batch file to copy the data at another time
Batch File: C:\Users\pholson\Desktop\copy_migrated_tables.cmd
Browse...
You should edit this file to add the source and target server passwords before running it.
New Fast Migration Option
Create a shell script to use native server dump and load abilities for fast migration
Bulk Data Copy Script: C:\Users\pholson\Desktop\bulk_copy_tables.cmd
Browse...
Edit the generated file and change passwords at the top of the generated script.
Run it on the source server to create a zip package containing a data dump as well as a load script.
Copy this to the target server, extract it and run the import script. See the script output for further details.
Options
Truncate target tables (ie. delete contents) before copying data
Worker tasks 2
Enable debug output for table copy
< Back
Next >
Cancel
Ready

SSL Certificate Generator

A new SSL certificate generation wizard was added. This new wizard helps create proper SSL certificates for both MySQL clients and MySQL servers. Connections in MySQL Workbench are updated with the certificates by the wizard. This wizard requires OpenSSL to create the certificates. An example `my.cnf` / `my.ini` file is also generated that utilizes the generated certificates.

Figure 1.2 SSL Certificate Wizard


SSL Wizard
Results
The wizard was sucessful. Click on the finish button to update the connection. To setup the server, you should copy the following files to a <directory> inside localhost:
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\ca_cert
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\server_cert
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\server_key
and configure the config file with the following parameters:
Copy this to your my.cnf file. Please change <directory> to the corresponding directory where the files were copied.
[client]
ssl-ca=<directory>\ca-cert.pem
ssl-cert=<directory>\client-cert.pem
ssl-key=<directory>\client-key.pem
[mysqld]
ssl-ca=<directory>\ca-cert.pem
ssl-cert=<directory>\server-cert.pem
ssl-key=<directory>\server-key.pem
A copy of this file can be found in:
C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\my.cnf.sample
< Back
Finish
Cancel

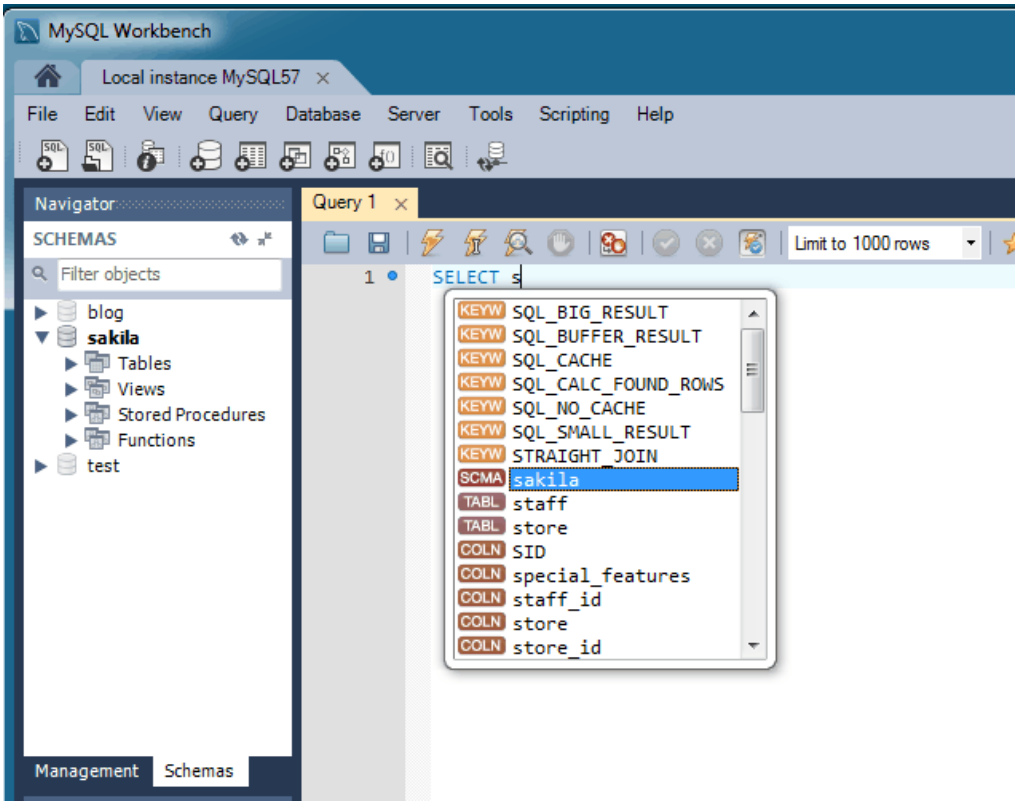
For additional details, see Section 5.3.4, “SSL Wizard (Certificates)”.

SQL Editor Auto-Completion

The SQL editor auto-completion improvements include the following changes:

- It now functions with all statement types, when before only SELECT statements were fully supported.
- It now minds the MySQL server version. For example, it now only shows the engines available from the server.
- Additional suggestions are now available, such as system variables, engines, table spaces, logfile groups, and more.
- New graphics including color coded (and tagged) entries.
- It is context aware, as for example it only shows available keywords, columns, and tables.
- Improved MySQL 5.7 syntax support.

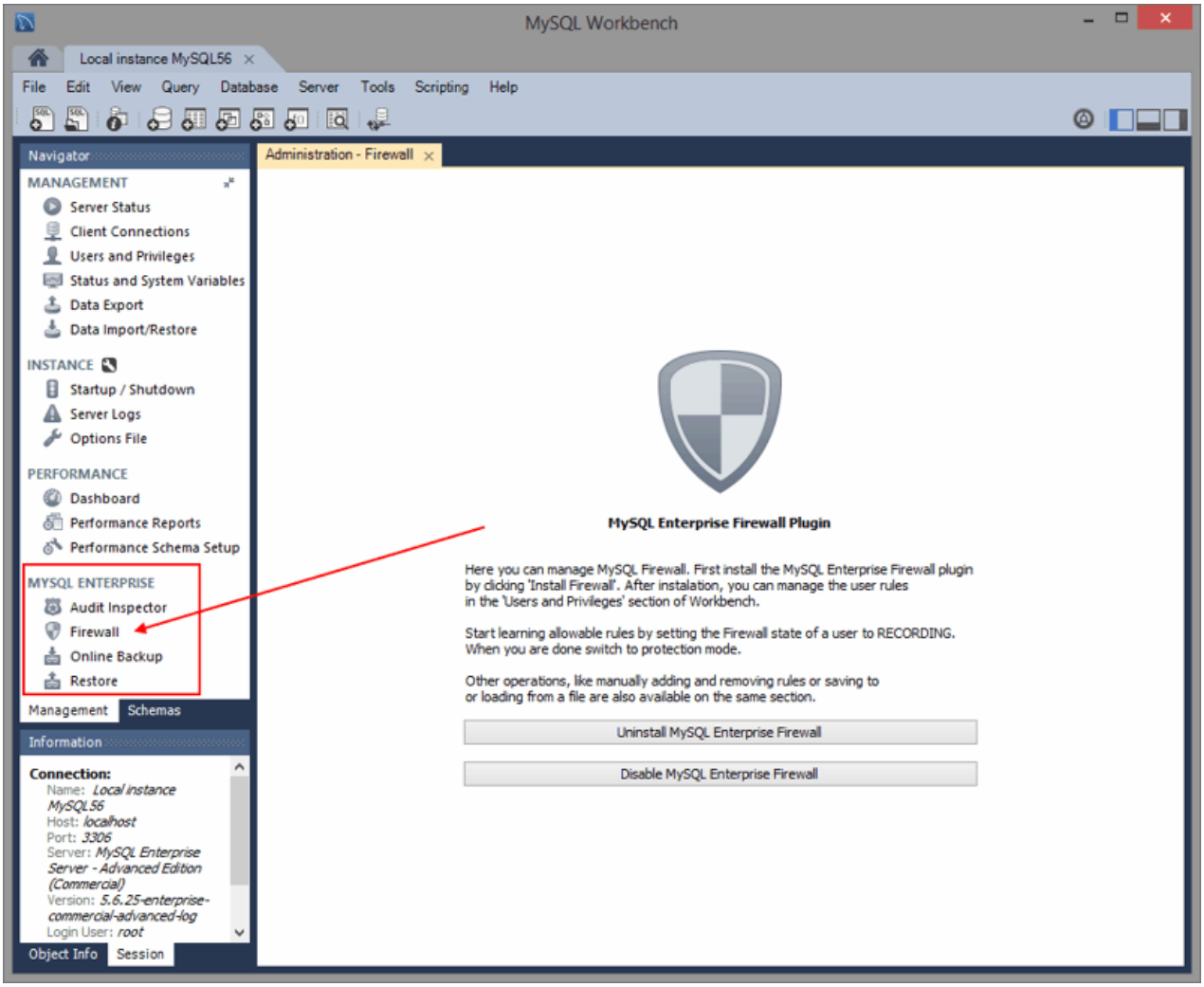
Figure 1.3 SQL Editor Auto-Completion



MySQL Enterprise Firewall

MySQL Enterprise Firewall support was added in MySQL Workbench 6.3.4. Use MySQL Workbench to install and enable MySQL Enterprise Firewall, and manage the MySQL Enterprise Firewall rules and variables. For additional information, see Section 6.8, “MySQL Enterprise Firewall Interface”.

Figure 1.4 MySQL Enterprise Firewall: Install / Enable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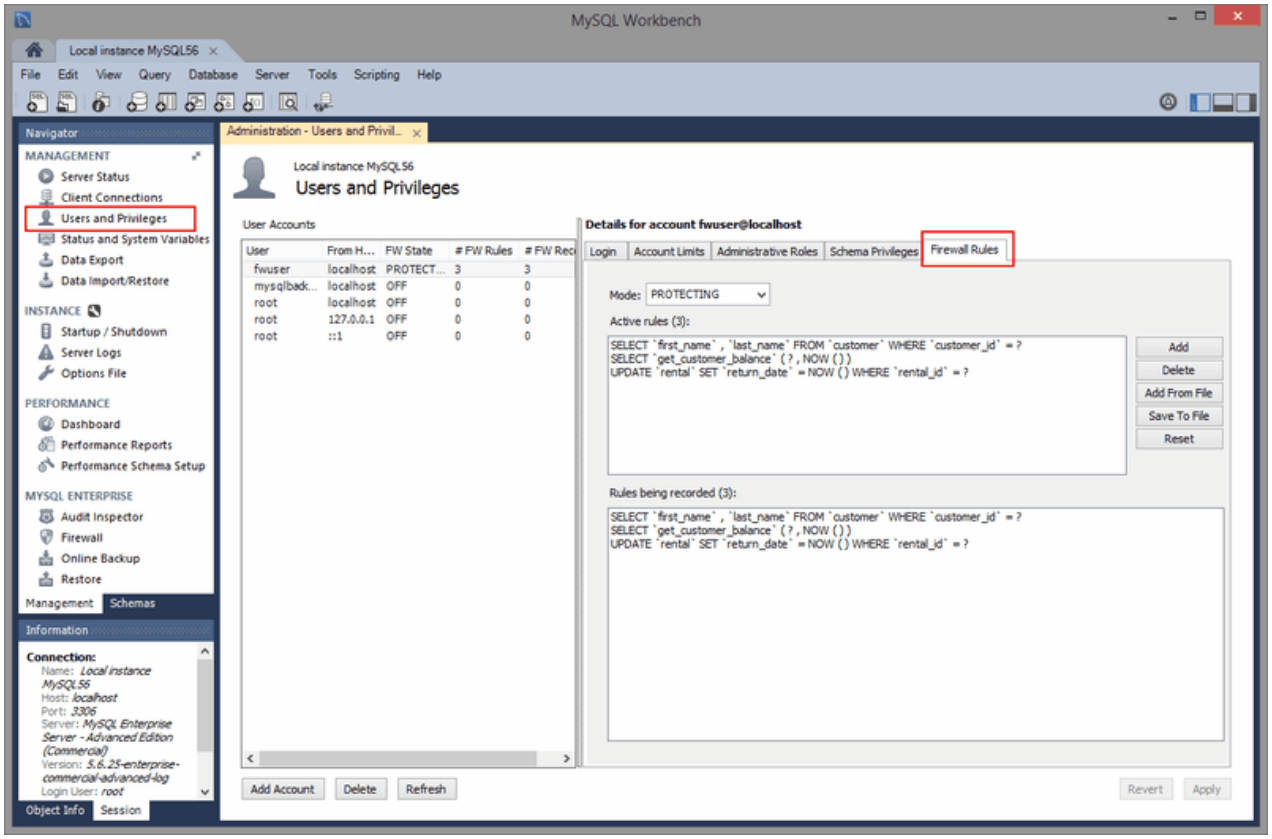
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MYSQL ENTERPRISE
Audit Inspector
Firewall
Online Backup
Restore
Management
Schemas
Information
Connection:
Name: Local instance MySQL56
Host: localhost
Port: 3306
Server: MySQL Enterprise Server - Advanced Edition (Commercial)
Version: 5.6.25-enterprise-commercial-advanced-log
Login User: root
Object Info
Session
Administration - Firewall
MySQL Enterprise Firewall Plugin
Here you can manage MySQL Firewall. First install the MySQL Enterprise Firewall plugin by clicking 'Install Firewall'. After instalation, you can manage the user rules in the 'Users and Privileges' section of Workbench.
Start learning allowable rules by setting the Firewall state of a user to RECORDING. When you are done switch to protection mode.
Other operations, like manually adding and removing rules or saving to or loading from a file are also available on the same section.
Uninstall MySQL Enterprise Firewall
Disable MySQL Enterprise Firewall

Figure 1.5 MySQL Enterprise Firewall Rules



MySQL Enterprise Backup

Profile handling now detects mismatches between MySQL Enterprise Backup executables and corresponding profiles.

Improved scheduling logic

Table Data Export and Import Wizard

A new table data import/export wizard was added. This feature enhances the current CSV import and export feature found in the SQL editor's result set viewer. It supports import and export of CSV and JSON files, and allows a more flexible configuration (separators, column selection, encoding selection, and more). This new wizard does not require an executed statement on a table for a result set to be operated on, as it can now work directly on tables. The wizard can be performed against either a local or remotely connected MySQL server. The import action includes table, column, and type mapping. For additional information, see Section 6.5.1, “Table Data Export and Import Wizard”.

The wizard is accessible from the object browser's context menu.

Figure 1.6 Table Data Import/Export Wizard Menu

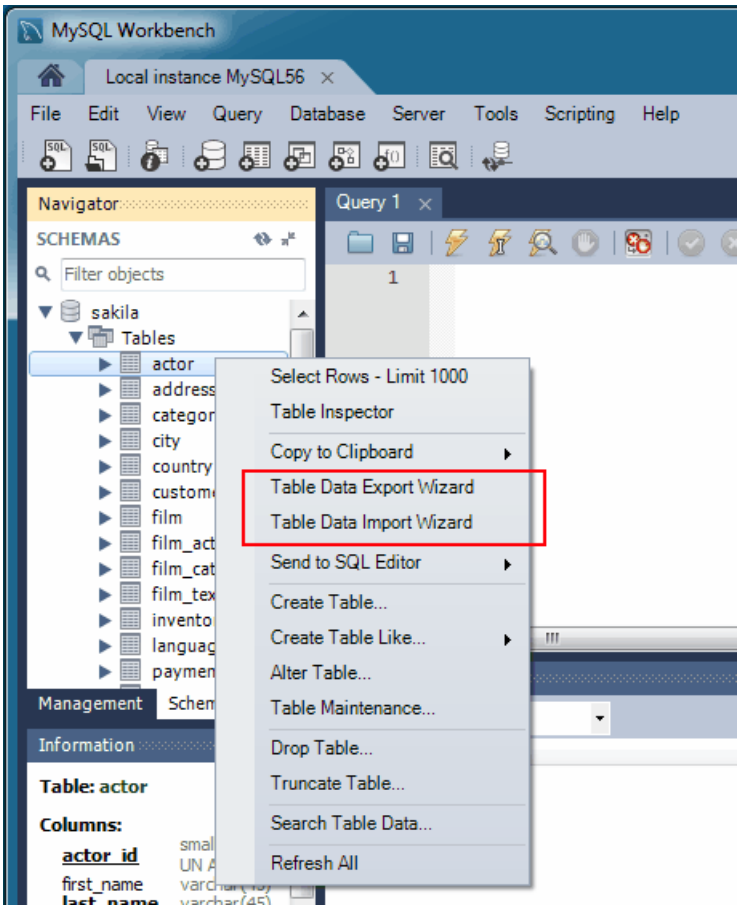


Figure 1.7 Table Data Import/Export Wizard CSV Configure

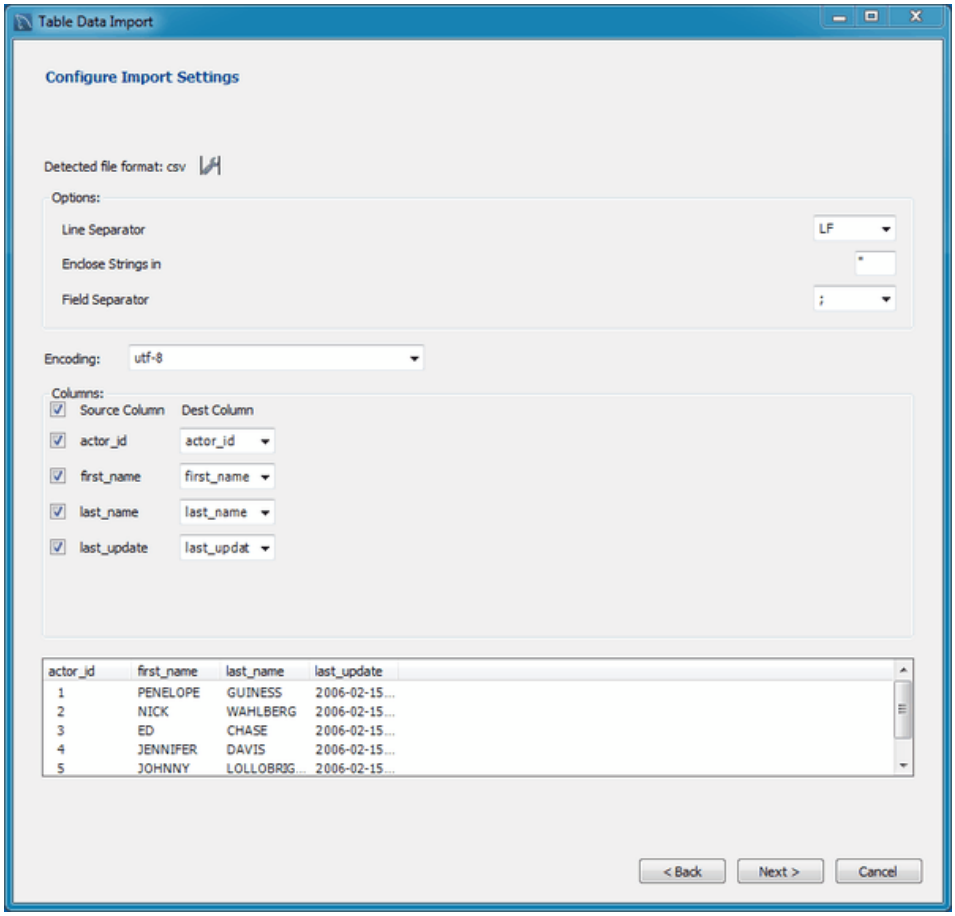
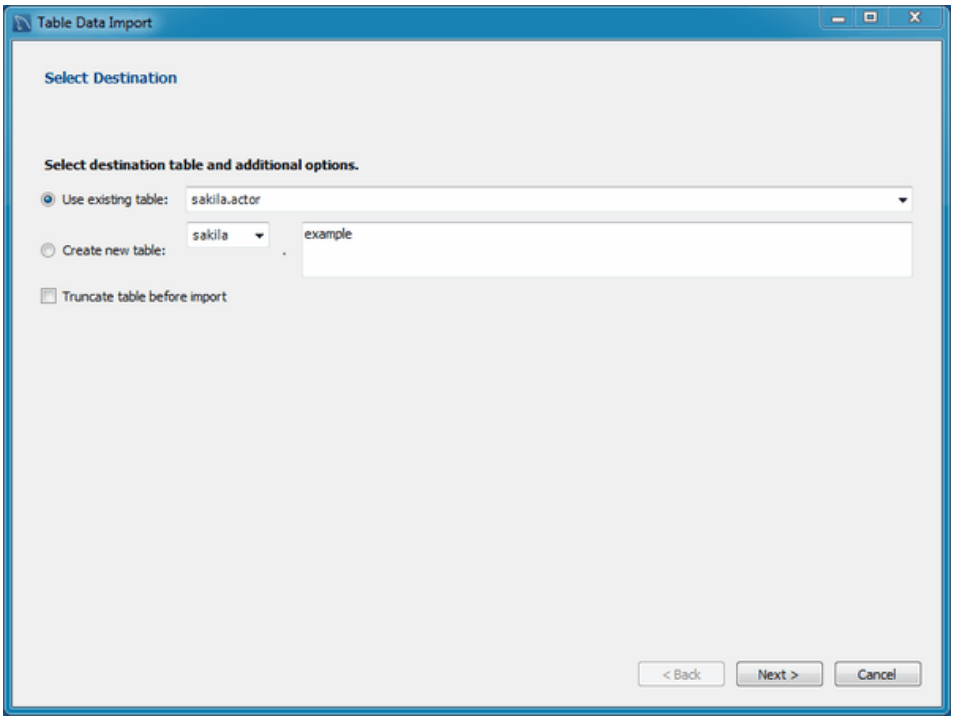


Figure 1.8 Table Data Import/Export Wizard Options



Additional changes

MySQL Fabric 1.5 is now supported. Older versions of Fabric are no longer supported due to incompatible protocol changes.

OS X builds were switched from 32-bit to 64-bit.

Platforms support changes: 6.3.0: Fedora 21 and Ubuntu 14.10 support was added, Ubuntu 12.10 support was dropped. 6.3.4: Fedora 22 and Ubuntu 15.04 support was added, Ubuntu 14.10 support was dropped.

1.1.2 New in MySQL Workbench 6.2

This section summarizes many of the new features added to MySQL Workbench 6.2.x, in relation to MySQL Workbench 6.1.x;.

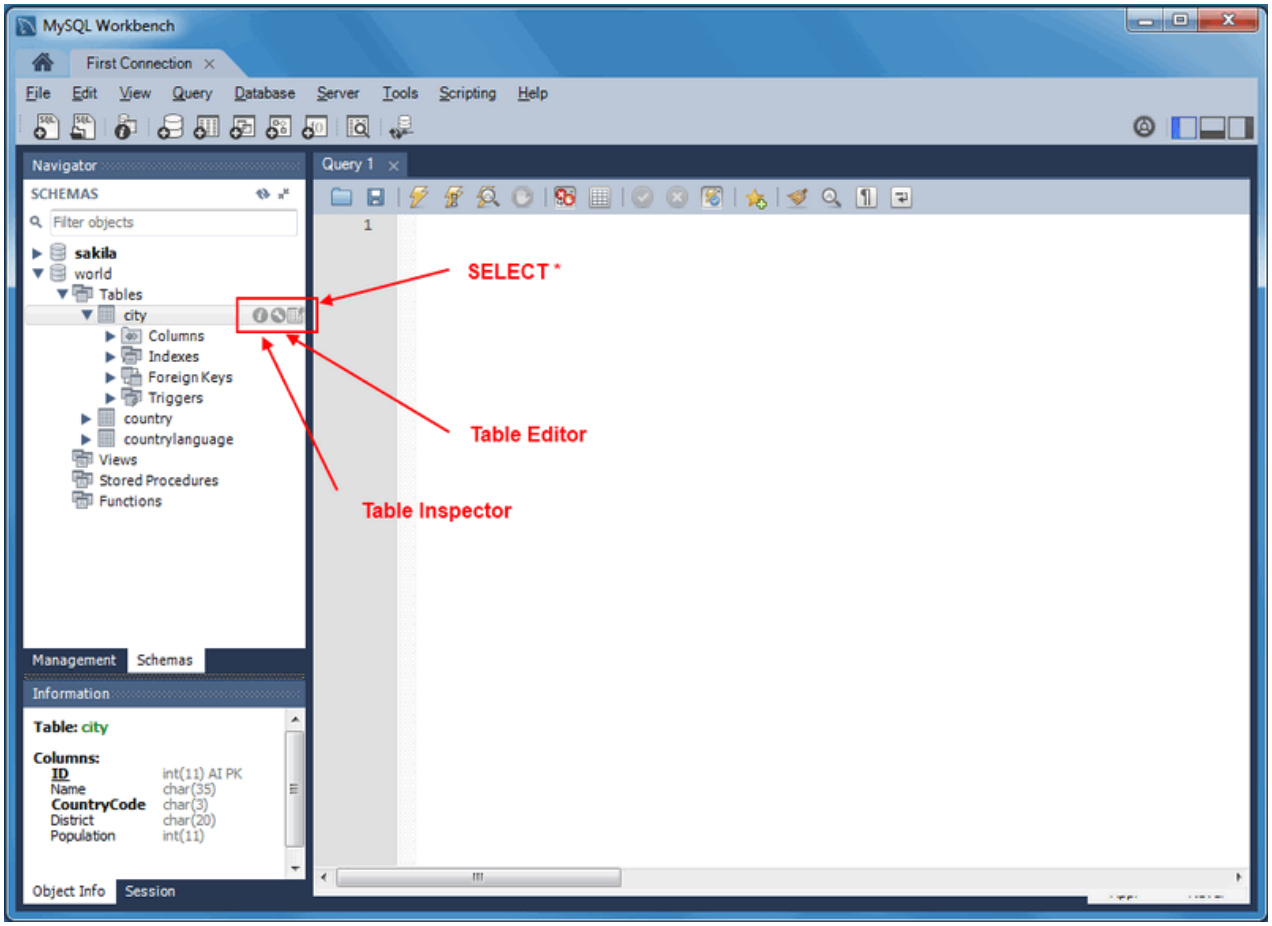
SQL Editor

Most of the changes and improvements were made to the SQL editor.

Overlay Icons in the Object Viewer

The schema navigator now includes shortcut buttons for common operations such as table data view, the table editor, and the table/schema inspector.

Figure 1.9 Object Viewer Overlay Icons



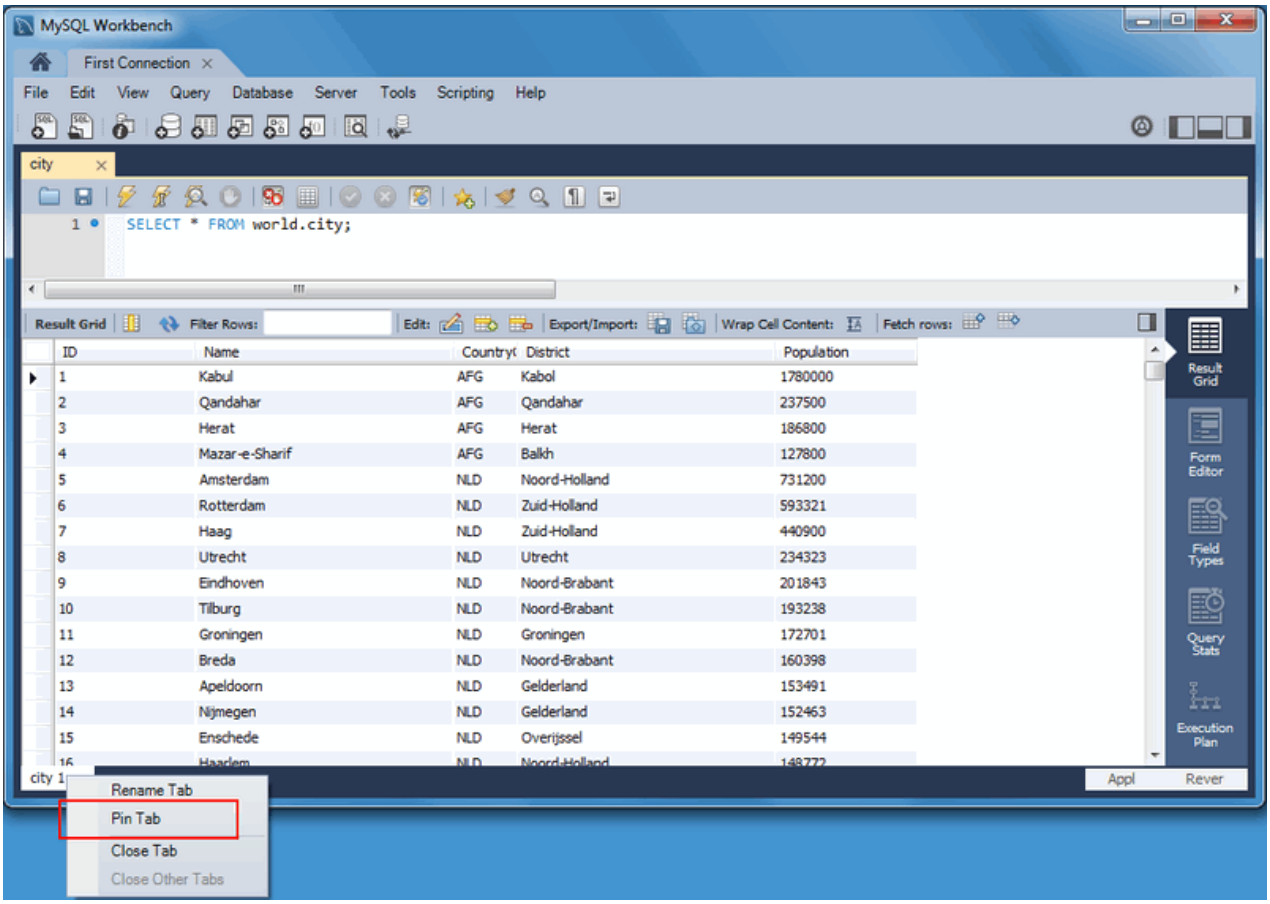
A "Pin Tab" Results Option

Result tabs can now be "pinned" to your result set window.

Note

The "Rename Tab" context menu option is also new. New names are preserved (and remembered) in your Workbench's `cache/` directory.

Figure 1.10 Pin Tab



Microsoft Access to MySQL Migration

The migration wizard now supports Microsoft Access migration. Select "Microsoft Access" as your source database in the wizard, use MySQL as your target source database, and then execute. For additional information, see Section 10.4, “Microsoft Access Migration”.

MySQL Fabric Integration

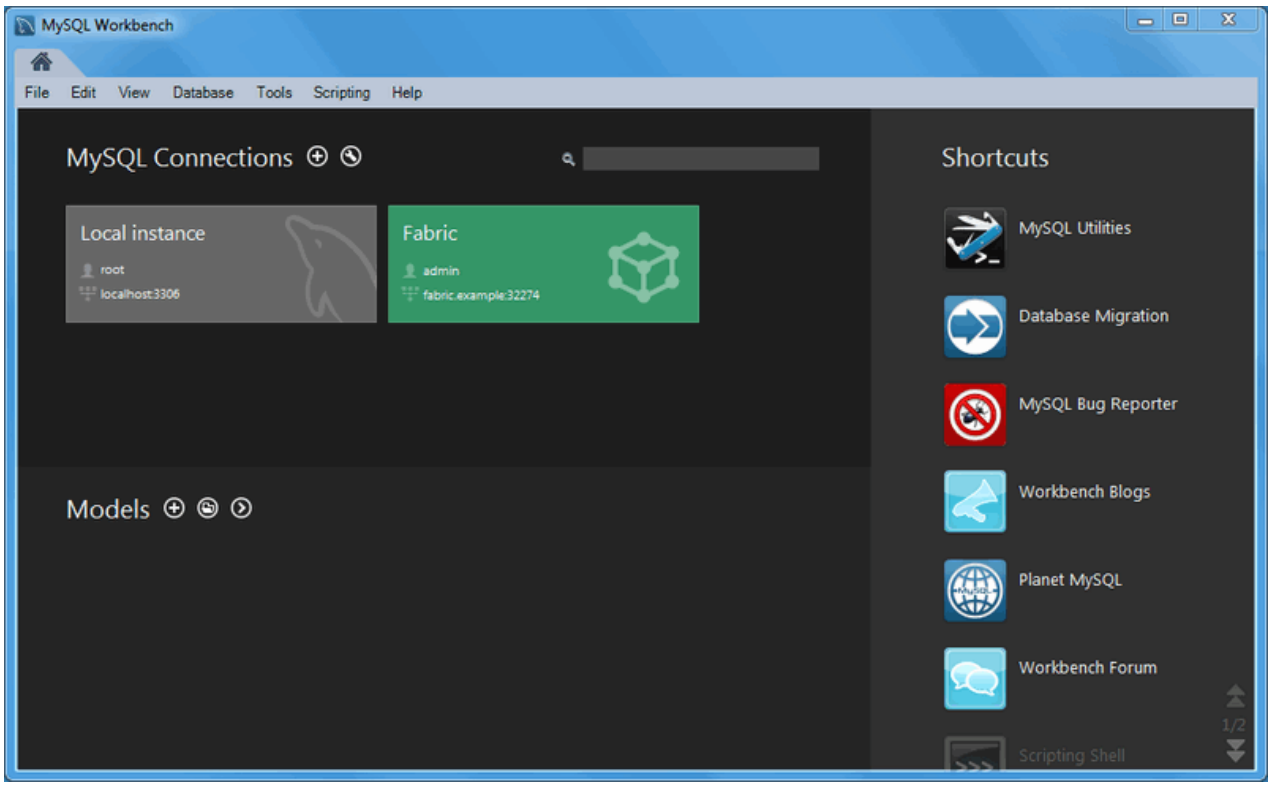
MySQL Fabric cluster connectivity was added: Browse, view status, and connect to any MySQL instance in a Fabric Cluster.

Note

This requires Connector/Python and MySQL Utilities 1.4.3+ installed, including the Python module.

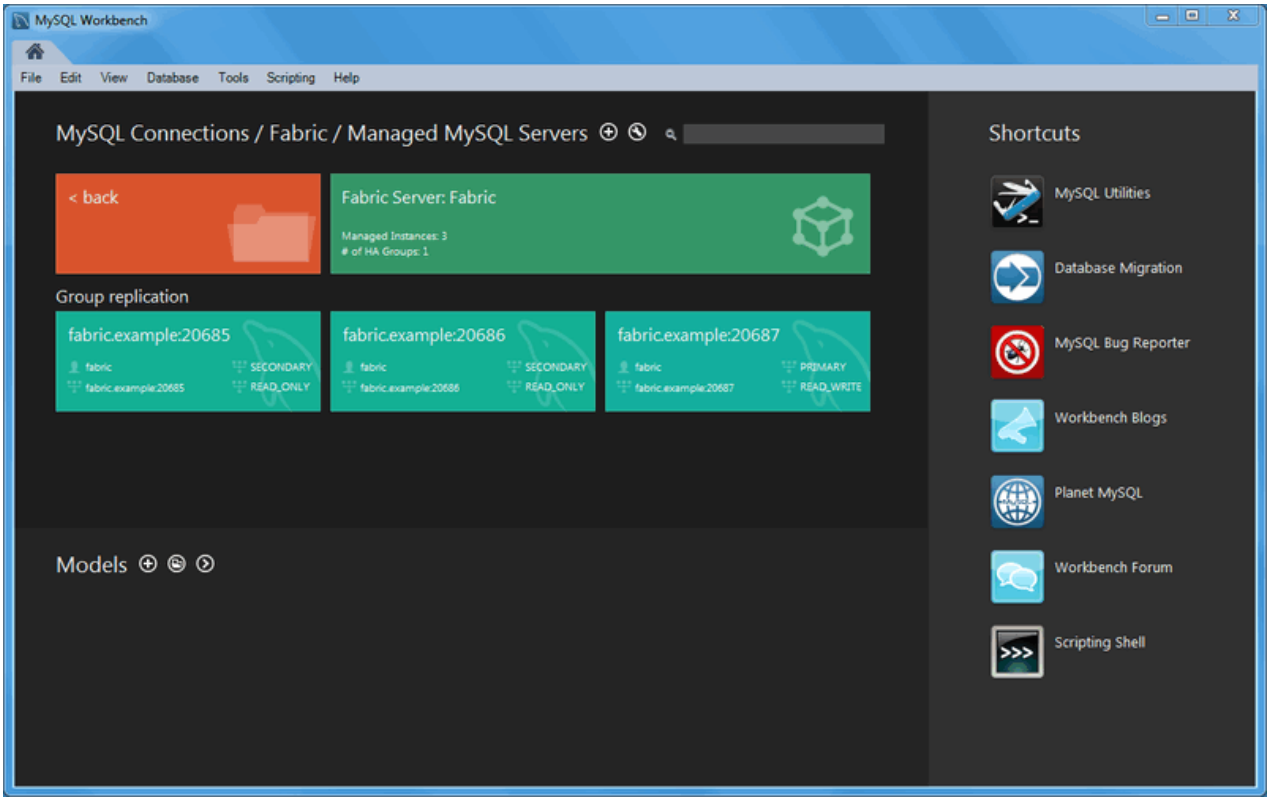
To set up a managed Fabric connection, create a new MySQL connection with the new MySQL Fabric Management Node connection method. The connection tiles have a different look:

Figure 1.11 Fabric Connection Group Tile



Clicking the new fabric group tile shows the managed connections:

Figure 1.12 Fabric Connection Group Tiles

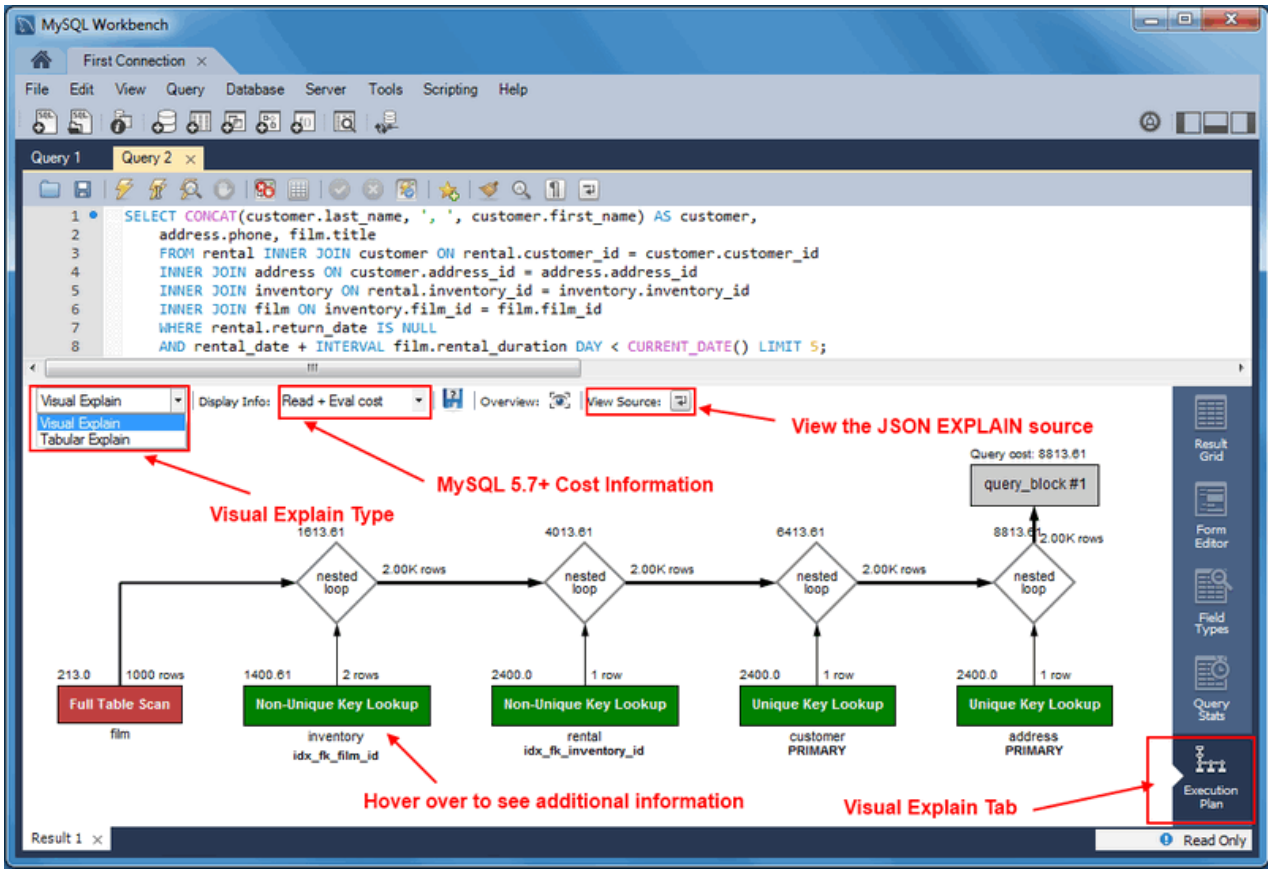


Visual Explain / Execution Plan Improvements

The Visual Explain **Execution Plan** feature was improved. A list of changes includes:

- An "Execution Plan" tab was added to the results view
- All statements now offer a "Visual Explain" execution plan
- The layout changed, and was improved to allow easier navigation in large query plans

Figure 1.13 Execution Plan Explained



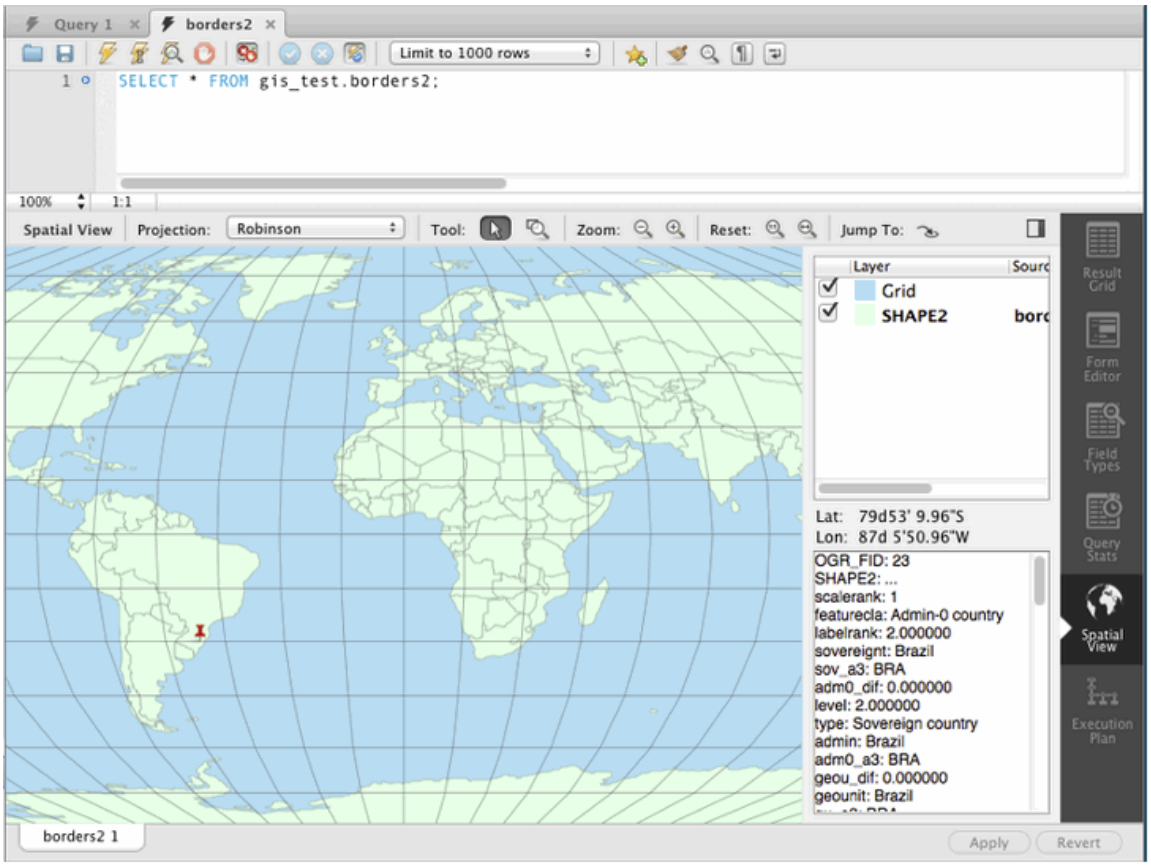
Spatial View Panel

GIS support for InnoDB tables is now supported to make it easier to visualize spatial and geometry data in a geographic context. The new spatial view panel renders data from each row into a separate and selectable element. When clicked, you can view the rest of the data from that row in the textbox. If you have multiple queries with geometry data, you can overlay them onto the same map. View options include the Robinson, Mercator, Equirectangular, and Bonne projection methods.

Note

GIS support for InnoDB tables was added in MySQL server 5.7.

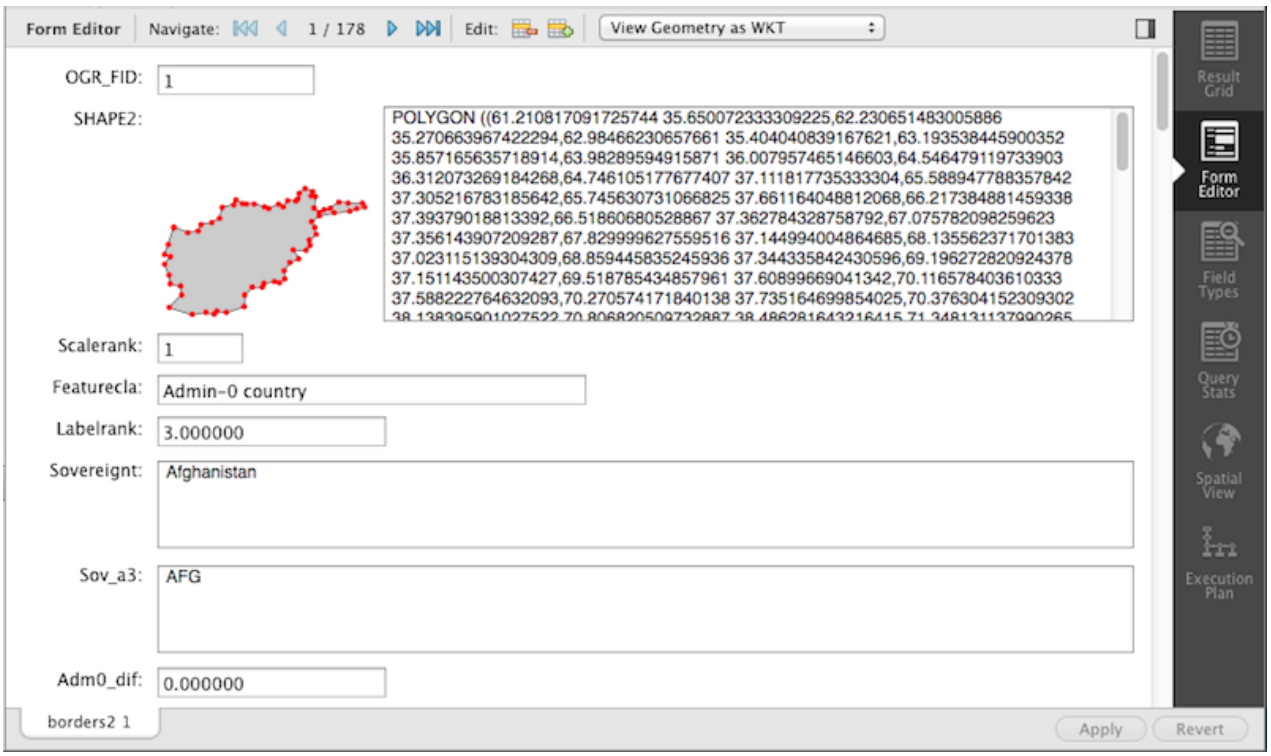
Figure 1.14 Spatial View Example



Geometry Data Viewer

The SQL field and form editors were updated to support the `GEOMETRY` datatype. You can view geometry data, such as polygons, from a single row as an image or as text. The available formats include WKT, GeoJSON, GML, and KML.

Figure 1.15 Geometry Data Viewer



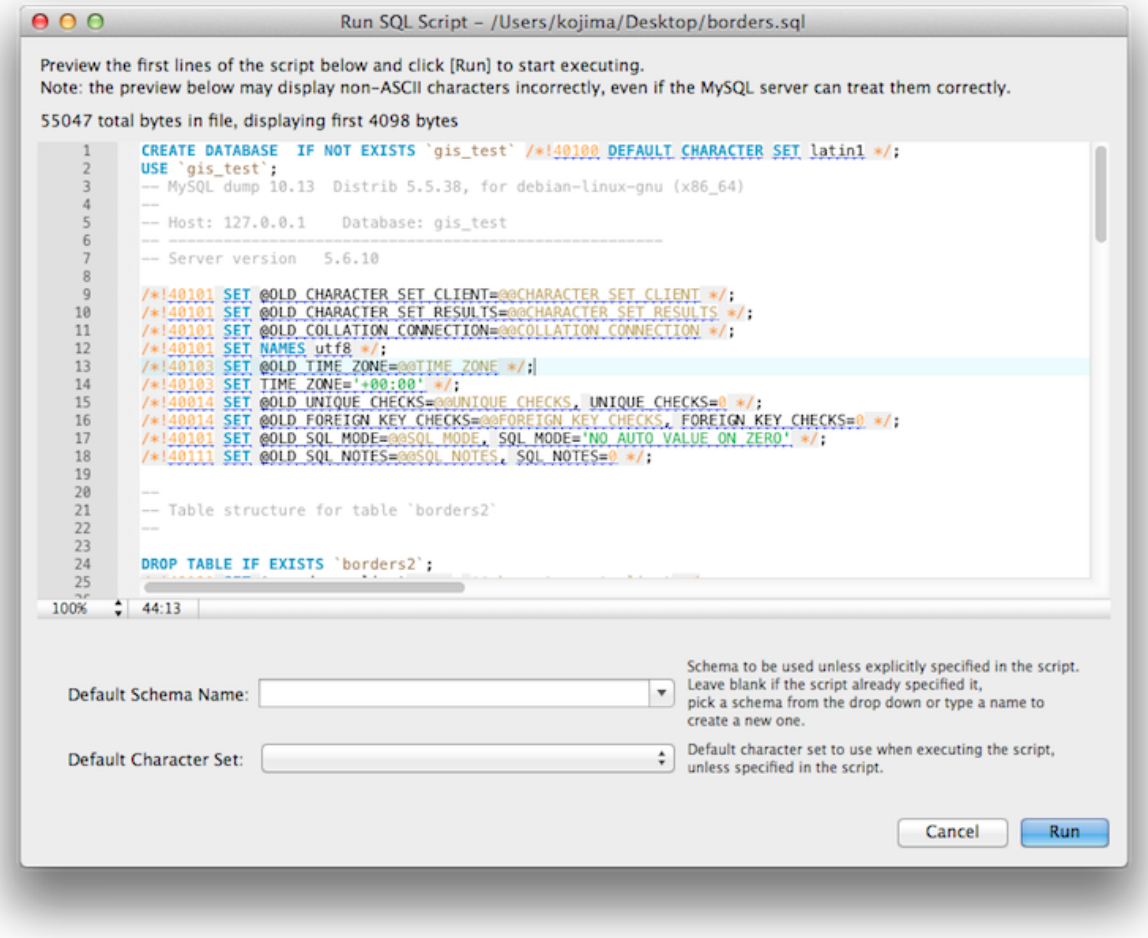
Additional New SQL Editor Features

- **Result Set Widths**: resized result set column widths are now preserved and remembered. This data is saved under Workbench's `cache/` directory using the *schema.table.column* format.
- Opened, closed, and reordered SQL editor tabs are now properly saved and restored. The scroll position and cursor locations are also remembered.
- **Shared Snippets**: these allow multiple users to share SQL code across a shared MySQL connection. They are stored in a schema named *.mysqlworkbench* on the connected MySQL server. by storing the snippets in a shared MySQL instance. For additional information, see Section 8.1.5, “SQL Snippets tab”.
- The full SQL syntax error is now viewable by hovering over the error response message.
- The **Query Status** tab was improved to include graphs and additional information.

Execute SQL Scripts

The new **Run SQL Script** dialog executes an SQL script without loading it into the SQL editor. This is useful because loading large scripts for editing can cause performance problems related to increased memory usage and required processing for editor features such as syntax highlighting, syntax checking, and code-folding. The dialog lets you preview a part of the script, optionally specify a default schema, and optionally set the default character set to use for the imported data. The output window shows warnings, messages, and an execution progression bar. Select Run SQL Script from the File menu to execute this wizard.

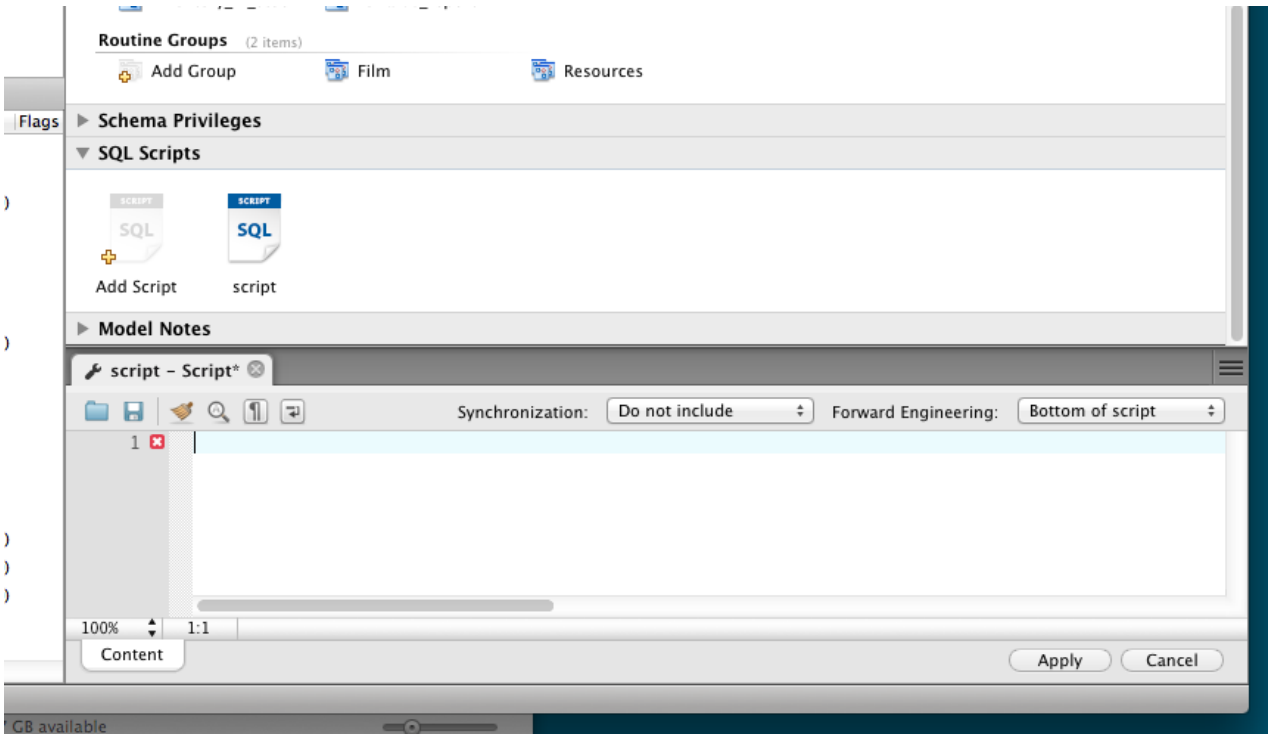
Figure 1.16 Run SQL Script


Run SQL Script – /Users/kojima/Desktop/borders.sql
Preview the first lines of the script below and click [Run] to start executing.
Note: the preview below may display non-ASCII characters incorrectly, even if the MySQL server can treat them correctly.
55047 total bytes in file, displaying first 4098 bytes
CREATE DATABASE IF NOT EXISTS `gis_test` /*!40100 DEFAULT CHARACTER SET latin1 */;
USE `gis_test`;
-- MySQL dump 10.13 Distrib 5.5.38, for debian-linux-gnu (x86_64)
--
-- Host: 127.0.0.1 Database: gis_test
-- --
-- Server version 5.6.10
/*!40101 SET @OLD_CHARACTER_SET_CLIENT=@@CHARACTER_SET_CLIENT */;
/*!40101 SET @OLD_CHARACTER_SET_RESULTS=@@CHARACTER_SET_RESULTS */;
/*!40101 SET @OLD_COLLATION_CONNECTION=@@COLLATION_CONNECTION */;
/*!40101 SET NAMES utf8 */;
/*!40103 SET @OLD_TIME_ZONE=@@TIME_ZONE */;
/*!40103 SET TIME_ZONE='+00:00' */;
/*!40014 SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0 */;
/*!40014 SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0 */;
/*!40101 SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='NO_AUTO_VALUE_ON_ZERO' */;
/*!40111 SET @OLD_SQL_NOTES=@@SQL_NOTES, SQL_NOTES=0 */;
--
-- Table structure for table `borders2`
--
DROP TABLE IF EXISTS `borders2`;
100%
44:13
Default Schema Name:
Schema to be used unless explicitly specified in the script.
Leave blank if the script already specified it,
pick a schema from the drop down or type a name to
create a new one.
Default Character Set:
Default character set to use when executing the script,
unless specified in the script.
Cancel
Run

Model Script Attachments

Previously, MySQL Workbench modeling supported attaching SQL script files to models, usually for documentation and organization purposes. You can now include attached SQL files to the output script when performing forward engineering or synchronization operations.

Figure 1.17 Data Modeling Script Attachments

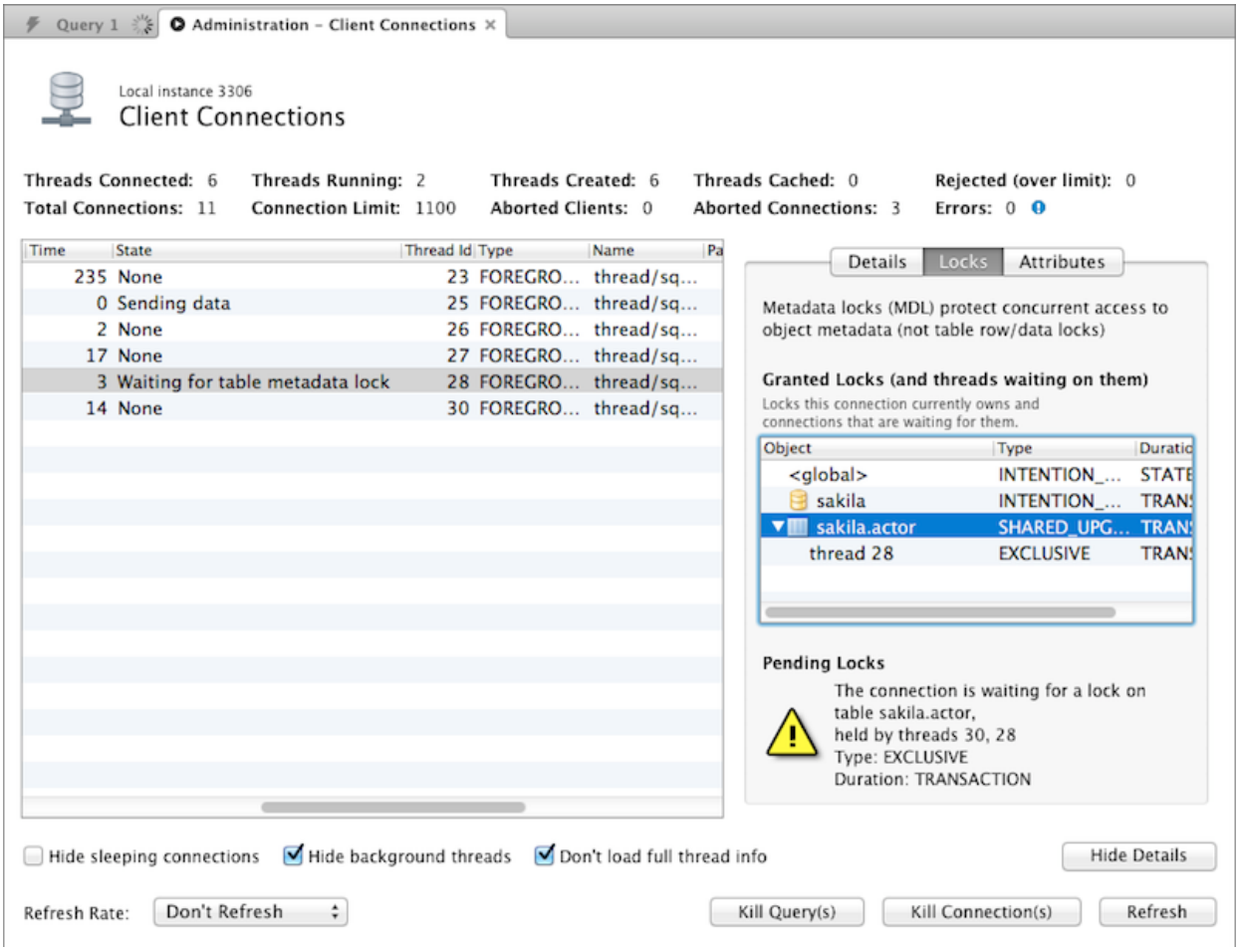


Client Connections and Metadata locks

The **Client Connections** management window has a new Show Details window. This window's three tabs are:

- **Details**: connection details such as Process ID, Type, User, Host, Instrumented, and additional information.
- **Locks**: MySQL uses metadata locking to manage access to objects such as tables and triggers. Sometimes a query might be blocked while being manipulated by another connection from another user. The **Locks** feature utilizes these MySQL metadata locks (MDL) to show the locked connections that are blocked or being waiting on, and shows information about the locks, what they are waiting for, and what they hold.

Figure 1.18 Metadata Locks Browser

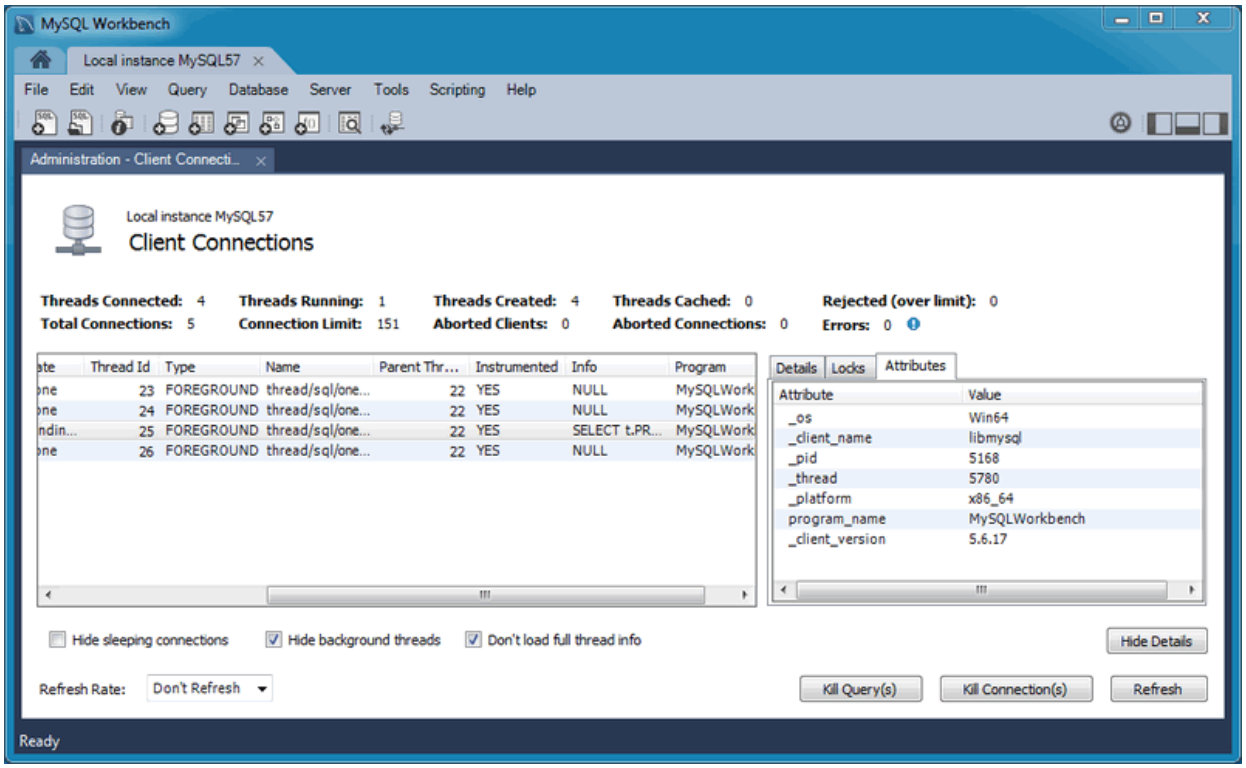


Note

The metadata lock information is provided in the performance schema as of MySQL server 5.7.3.

- **Attributes**: these are connection attributes such as OS, Client Name, Client Version, and Platform.

Figure 1.19 Client Connection Attributes



Note

This feature uses performance schema details from MySQL server 5.7 and above.

For additional information, see Section 5.5, “Client Connections”.

Additional New Features

- Performance columns (that display sizes) now have an option to alter the value units. They can be set to KB, MB, or GB. Right-click on a column header and choose **Set Display Unit**.
- The migration wizard can now resume operation if a data copy failed during a database migration from, for example, a timeout or network failure. Click Resume retry the data copy, and MySQL Workbench locates the last row that was copied successfully and attempts to restart the copy from that row.
- The MySQL connection password is now remembered across the MySQL Workbench session, even if it not stored in the keychain. This is so you do not need to re-enter it whenever a new MySQL connection is needed.
- Under Modeling, the Role Editor now has "Add Everything" and "Check All Privileges" options.
- The **Preferences** layout changed. The tabs were replaced by a list using a horizontal sidebar, and additional category names were added. For additional information, see Section 3.2, “Workbench Preferences”.
- Keyboard shortcuts now function in the *Scripting Shell*.
- **Model diagram notes** can now be resized and automatically rearranged. You can also change the style attributes such as the font, background color, and text color.

Figure 1.20 Model Diagram Note Formatting

1.1.3 New in MySQL Workbench 6.1

This section summarizes many of the new features added to MySQL Workbench 6.1.x, in relation to MySQL Workbench 6.0.x;.

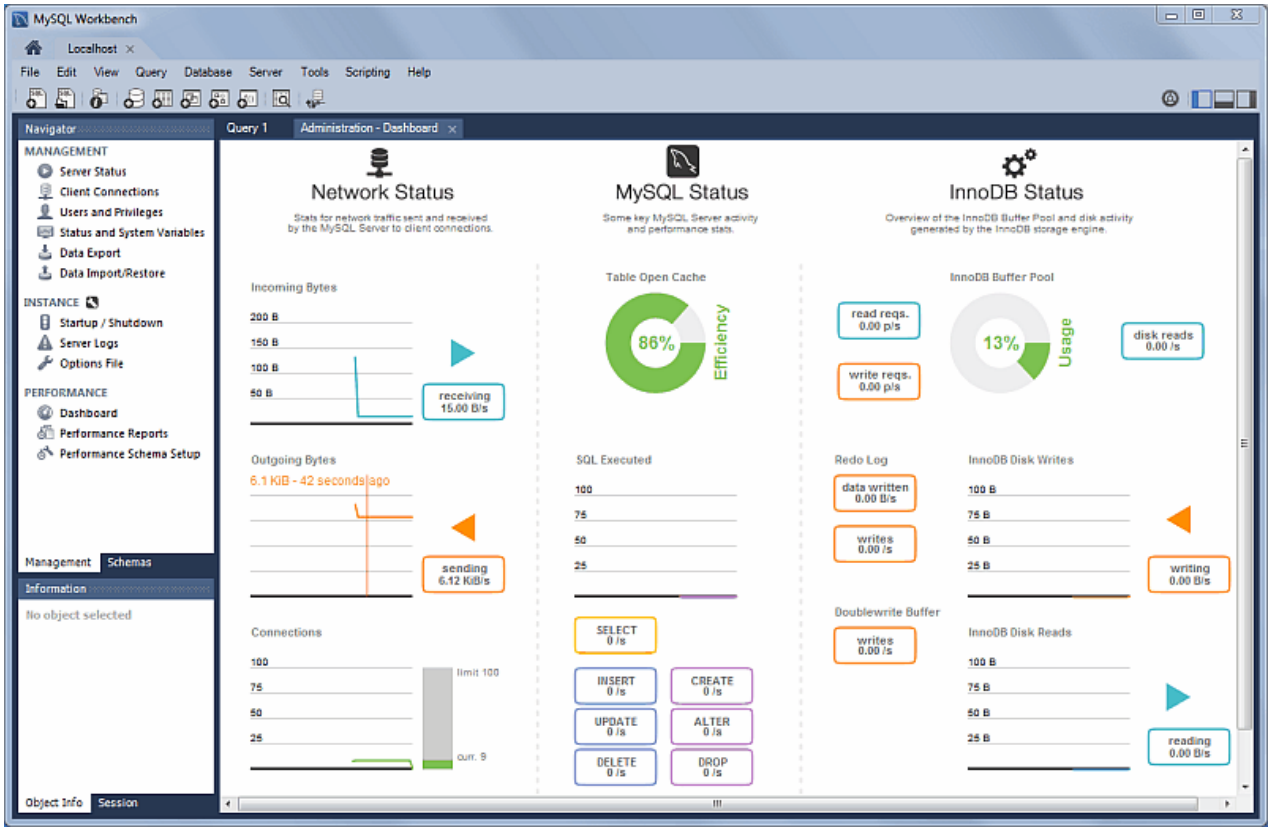
New Navigator PERFORMANCE Section

The new **PERFORMANCE** section includes **Dashboard**, **Performance Reports**, and **Performance Schema Setup** pages. Generally, this new performance reporting feature provides a graphical representation of key statistics from the MySQL server status, and provides an overview of the MySQL server subsystems.

Dashboard

View server performance statistics in a graphical dashboard.

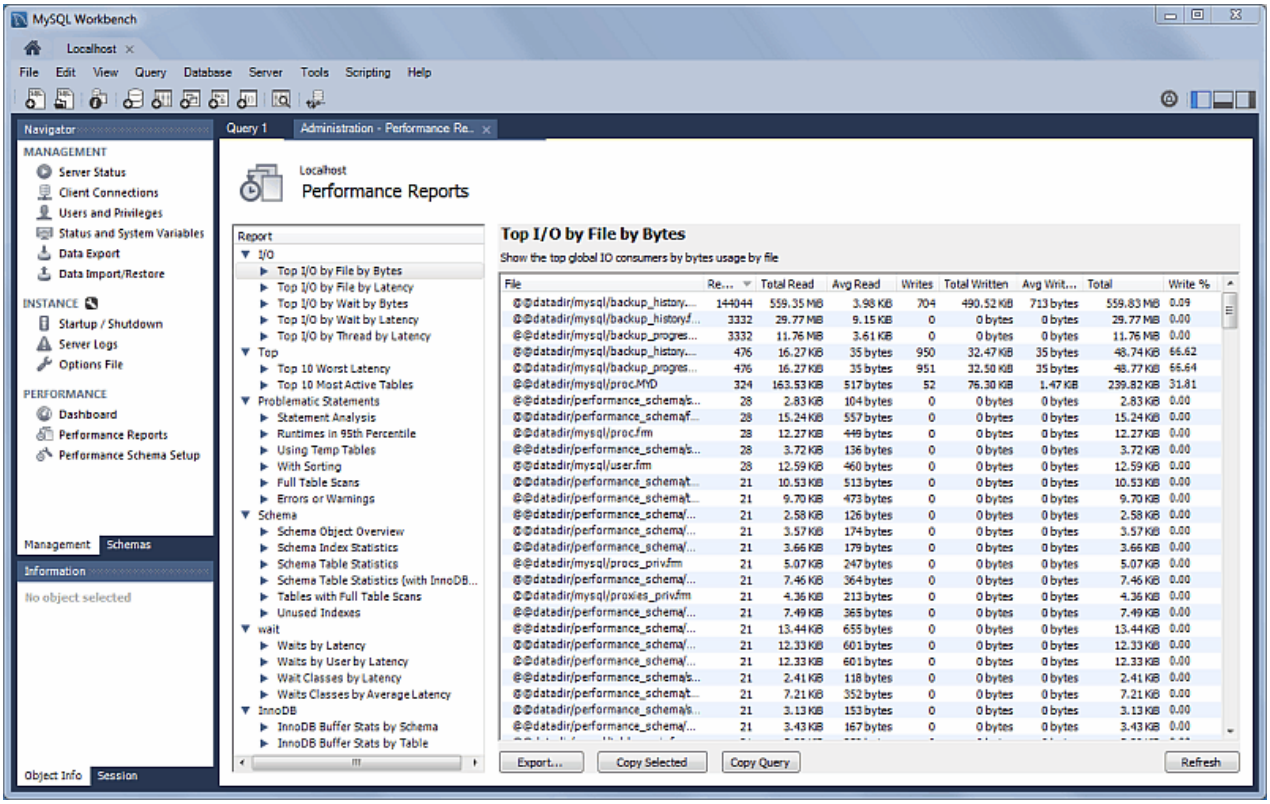
Figure 1.21 Performance Dashboard



Performance Reports

Performance schema based reports that provide insight into the operation of the MySQL server through many high-level reports.

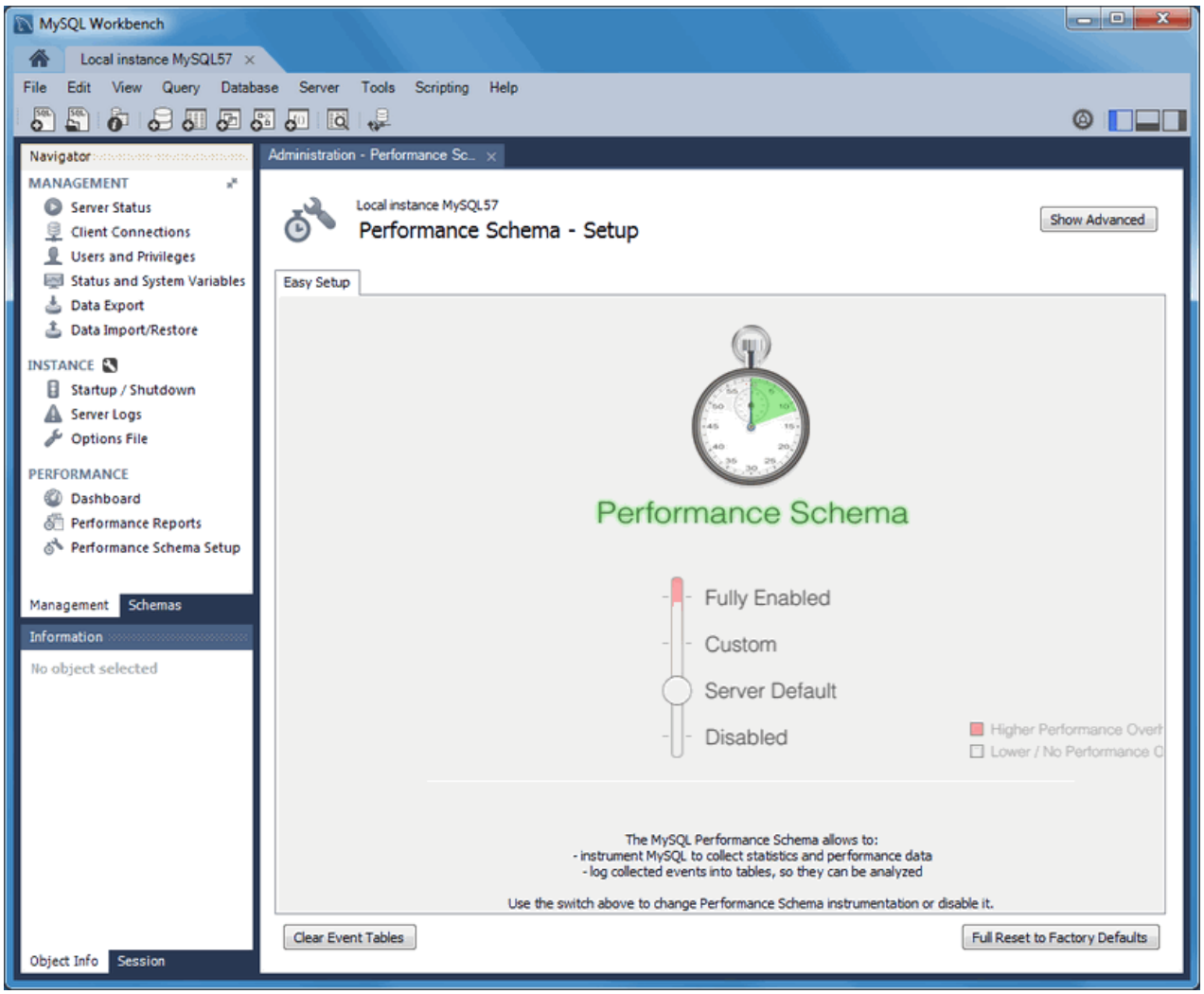
Figure 1.22 Performance Reports: Top I/0 By Bytes



Performance Schema Setup

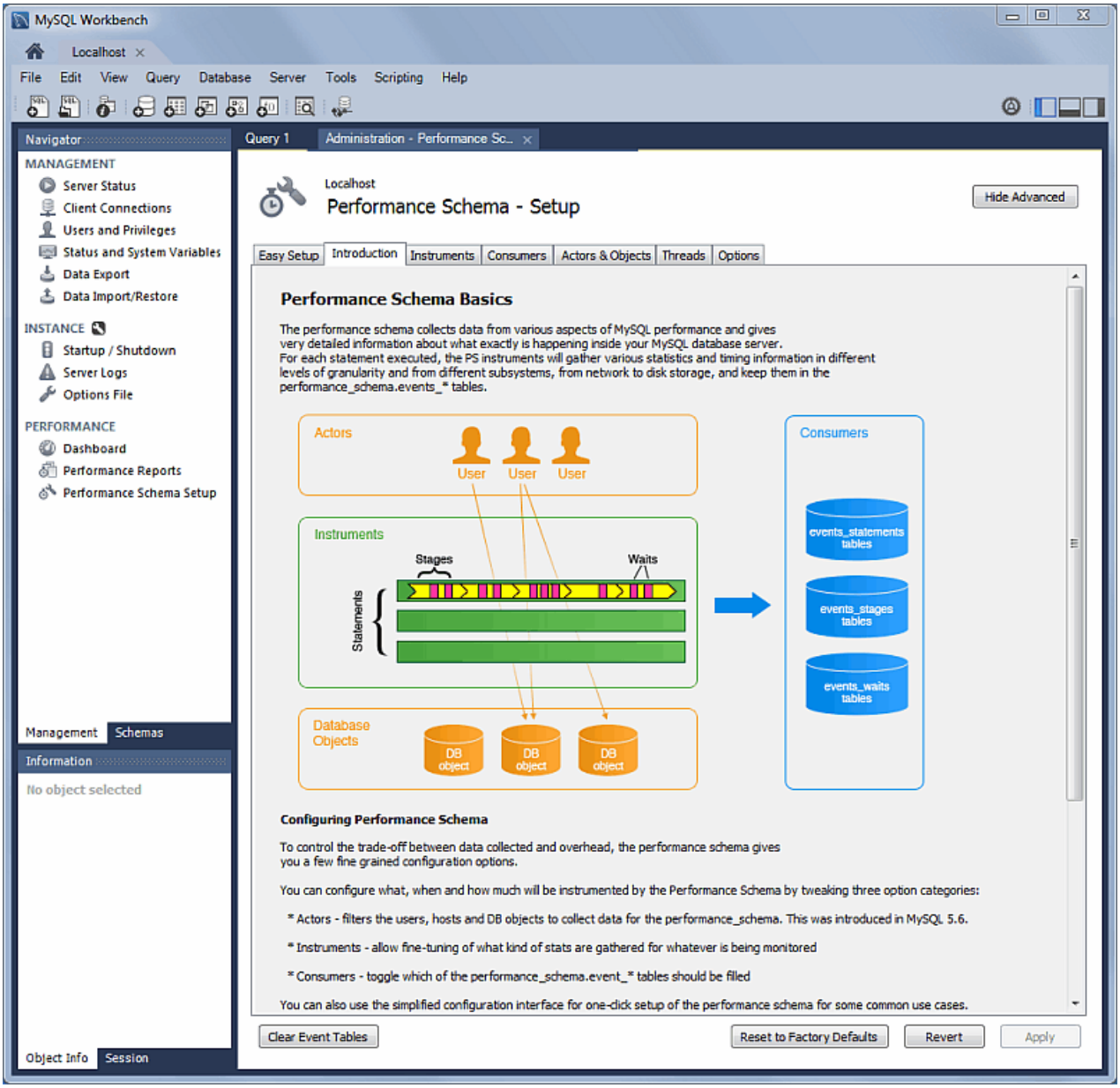
A GUI for configuring and fine tuning the Performance Schema instrumentation. Initially, this loads an "Easy Setup" page that is enough for most users. Slide the "Performance Schema Full Enabled" slider to **YES** to enable all available Performance Schema instruments.

Figure 1.23 Performance Schema Setup: Easy Setup



Clicking Show Advanced provides methods to fine tune the Performance Schema instrumentation.

Figure 1.24 Performance Schema Setup: Introduction


MySQL Workbench
Localhost
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
Query 1
Administration - Performance Sc...
Localhost
Performance Schema - Setup
Hide Advanced
Easy Setup Introduction Instruments Consumers Actors & Objects Threads Options
Performance Schema Basics
The performance schema collects data from various aspects of MySQL performance and gives very detailed information about what exactly is happening inside your MySQL database server. For each statement executed, the PS instruments will gather various statistics and timing information in different levels of granularity and from different subsystems, from network to disk storage, and keep them in the performance_schema.events_* tables.
Actors
User User User
Instruments
Stages
Waits
Statements
Database Objects
DB object DB object DB object
Consumers
events_statements tables
events_stages tables
events_waits tables
Configuring Performance Schema
To control the trade-off between data collected and overhead, the performance schema gives you a few fine grained configuration options.
You can configure what, when and how much will be instrumented by the Performance Schema by tweaking three option categories:
* Actors - filters the users, hosts and DB objects to collect data for the performance_schema. This was introduced in MySQL 5.6.
* Instruments - allow fine-tuning of what kind of stats are gathered for whatever is being monitored
* Consumers - toggle which of the performance_schema.event_* tables should be filled
You can also use the simplified configuration interface for one-click setup of the performance schema for some common use cases.
Clear Event Tables
Reset to Factory Defaults
Revert
Apply

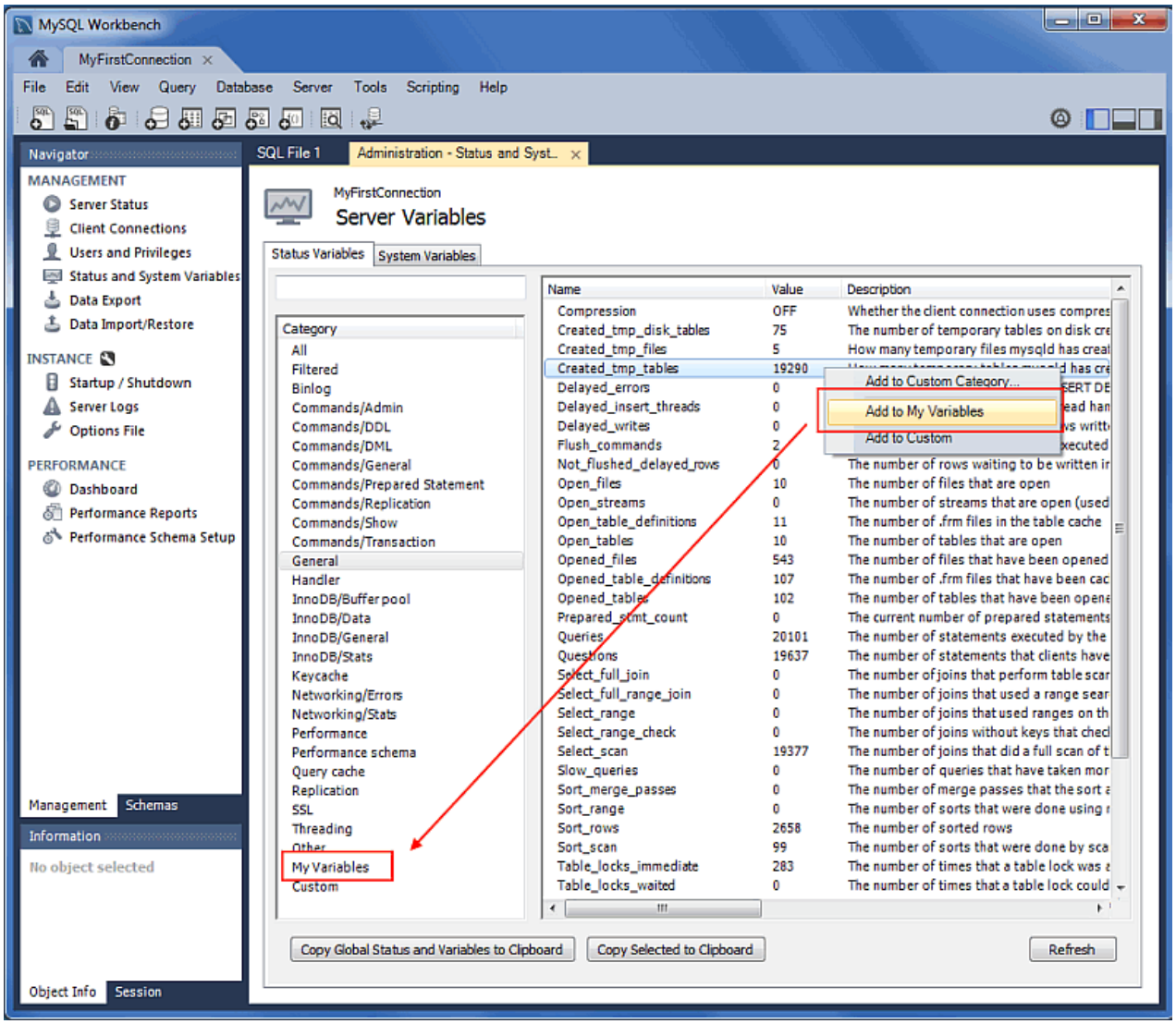
For additional information, see Chapter 7, *Performance Tools*.

Server Variable Groupings

Variables can now be organized using custom groupings in the **Status and System Variables** Management tab.

To create a custom group, right-click on a variable and choose either Add to Custom Category (to create a new category), or an existing custom category. For additional information, see Section 6.4, “Status and System Variables”.

Figure 1.25 Status And System Variables: Custom


MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
SQL File 1
Administration - Status and Syst...
MyFirstConnection
Server Variables
Status Variables System Variables
Category
All
Filtered
Binlog
Commands/Admin
Commands/DDL
Commands/DML
Commands/General
Commands/Prepared Statement
Commands/Replication
Commands/Show
Commands/Transaction
General
Handler
InnoDB/Buffer pool
InnoDB/Data
InnoDB/General
InnoDB/Stats
Keycache
Networking/Errors
Networking/Stats
Performance
Performance schema
Query cache
Replication
SSL
Threading
Other
My Variables
Custom
Name Value Description
Compression OFF Whether the client connection uses compres
Created_tmp_disk_tables 75 The number of temporary tables on disk cre
Created_tmp_files 5 How many temporary files mysqld has creat
Created_tmp_tables 19290
Delayed_errors 0
Delayed_insert_threads 0
Delayed_writes 0
Flush_commands 2
Not_flushed_delayed_rows 0 The number of rows waiting to be written in
Open_files 10 The number of files that are open
Open_streams 0 The number of streams that are open (used
Open_table_definitions 11 The number of .frm files in the table cache
Open_tables 10 The number of tables that are open
Opened_files 543 The number of files that have been opened
Opened_table_definitions 107 The number of .frm files that have been cac
Opened_tables 102 The number of tables that have been opene
Prepared_stmt_count 0 The current number of prepared statements
Queries 20101 The number of statements executed by the
Questions 19637 The number of statements that clients have
Select_full_join 0 The number of joins that perform table scan
Select_full_range_join 0 The number of joins that used a range sear
Select_range 0 The number of joins that used ranges on th
Select_range_check 0 The number of joins without keys that chec
Select_scan 19377 The number of joins that did a full scan of t
Slow_queries 0 The number of queries that have taken mor
Sort_merge_passes 0 The number of merge passes that the sort a
Sort_range 0 The number of sorts that were done using r
Sort_rows 2658 The number of sorted rows
Sort_scan 99 The number of sorts that were done by sca
Table_locks_immediate 283 The number of times that a table lock was a
Table_locks_waited 0 The number of times that a table lock could
Add to Custom Category...
Add to My Variables
Add to Custom
Copy Global Status and Variables to Clipboard
Copy Selected to Clipboard
Refresh

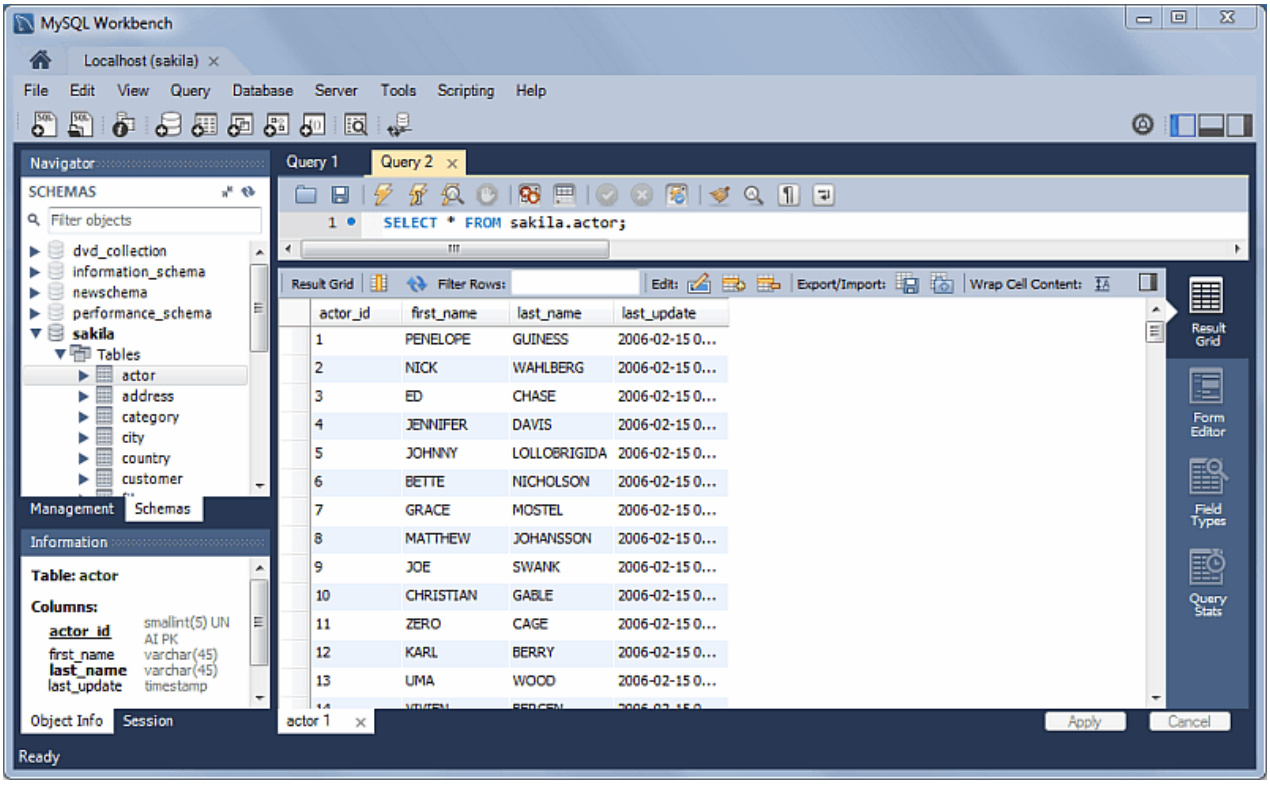
SQL Editor Views

Additional viewing options were added for executed statements:

Result Grid

Available previously, and it remains the default view.

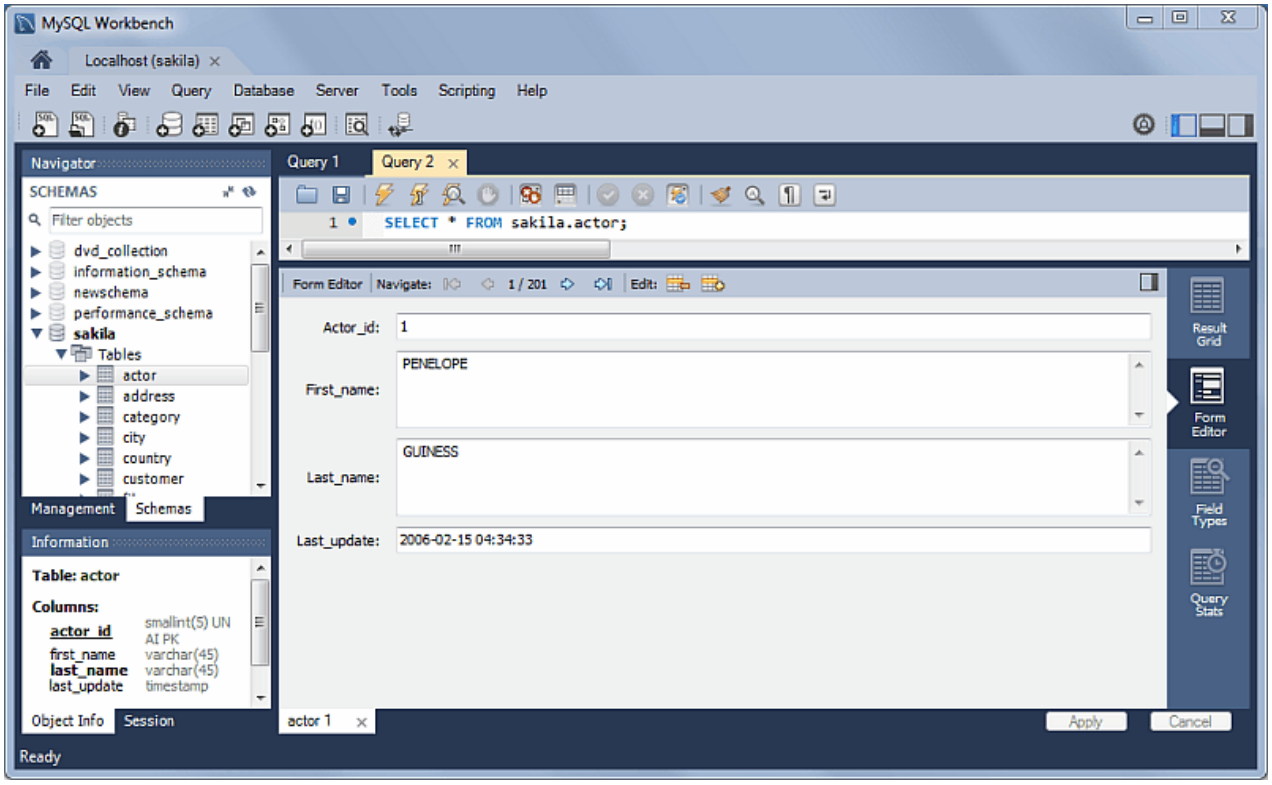
Figure 1.26 SQL Editor: Result Grid



Form Editor

You can now edit records row by row in a form style editor.

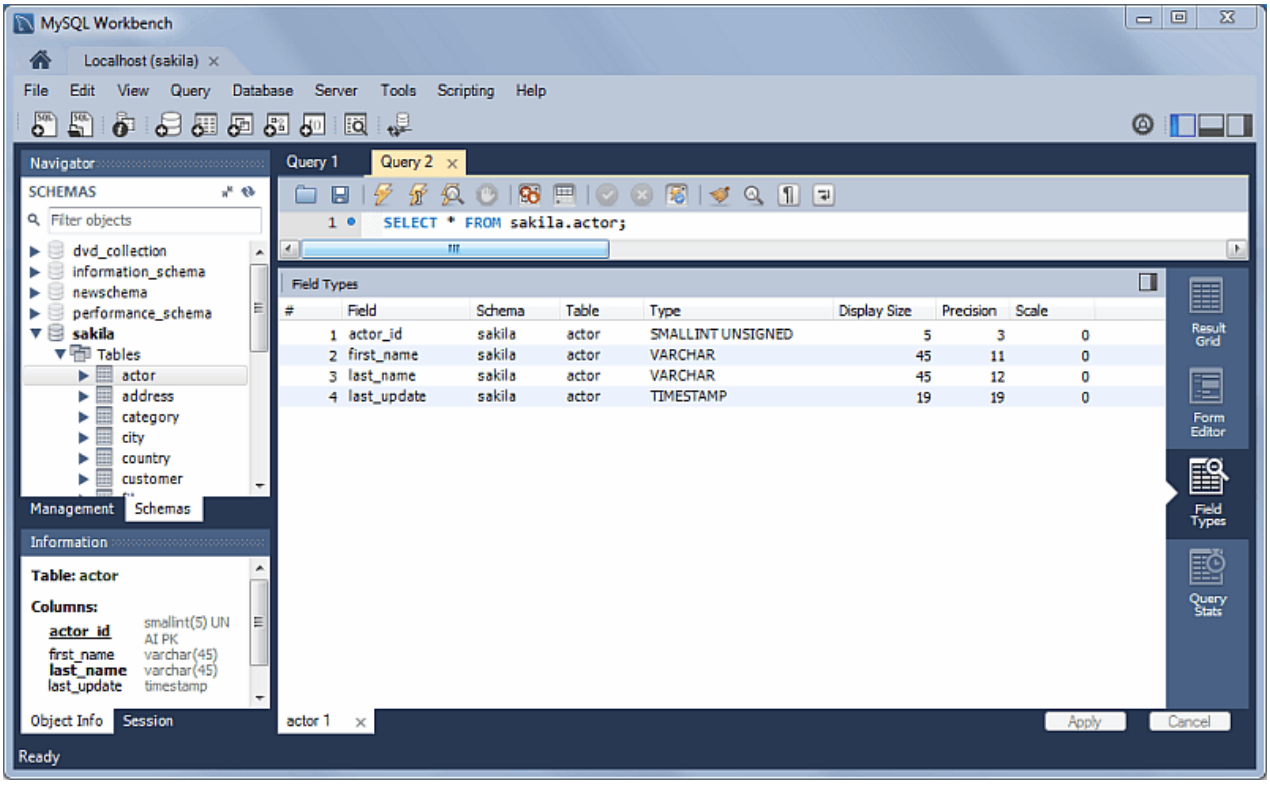
Figure 1.27 SQL Editor: Form Editor



Field Types

Displays information about the selected fields, similar to passing in `--column-type-info` from the command line client.

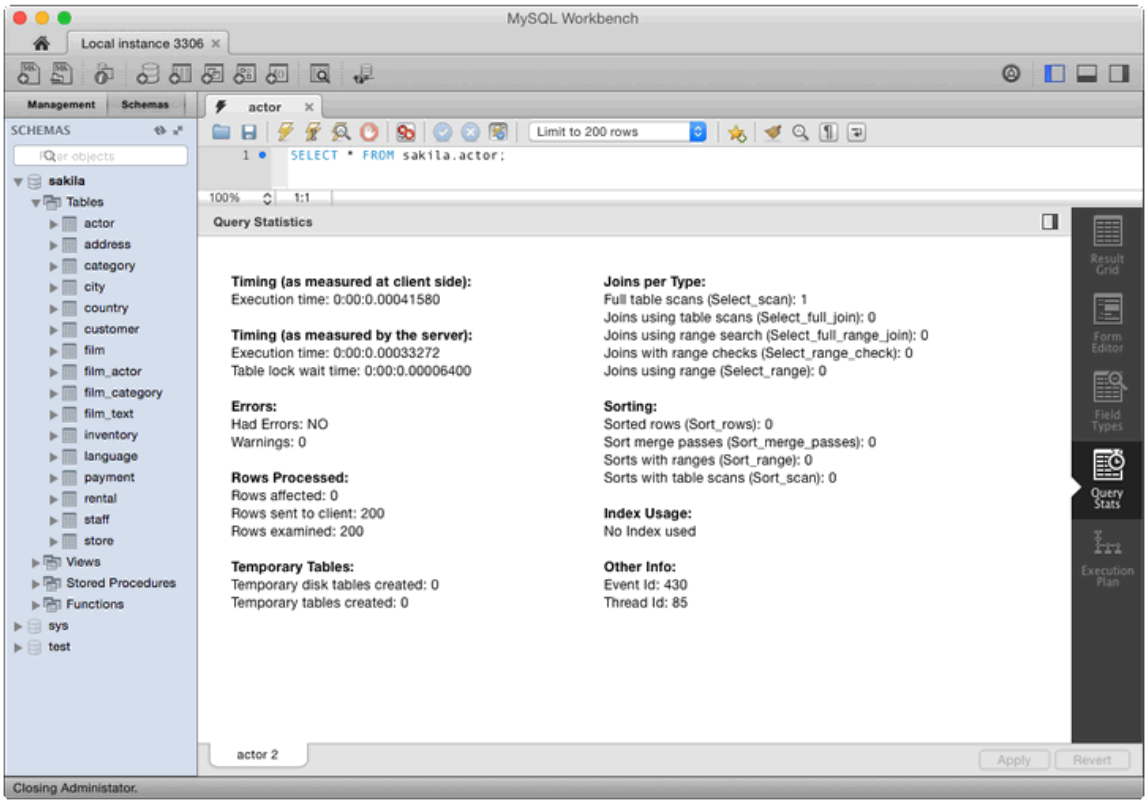
Figure 1.28 SQL Editor: Field Types



Query Stats

Query statistics are taken from the Performance Schema, and includes information about timing, temporary tables, indexes, joins, and more.

Figure 1.29 SQL Editor: Query Stats



Home Screen Features

Several behavioral improvements were made to the MySQL Workbench Home screen, including:

- Connection tiles can now be repositioned by using drag and drop
- A script or model file can be dragged into a MySQL connection tile
- The following right-click options were added to the connection tiles: Copy JDBC Connection String and Copy Connection String
- Right-clicking a blank area in the **MySQL Connections** area now offers an option to create a New Connection From Clipboard

Visual Explain

The layout changed, and additional information is now viewable by hovering over the fields. It also displays traditional `EXPLAIN` output in a separate tab, and the **Raw Explain Data** (as JSON) in another. For MySQL server 5.7+, the new "cost information" (such as "query_cost" and "sort_cost) is also utilized.

Figure 1.30 Visual Explain: Workbench 6.0

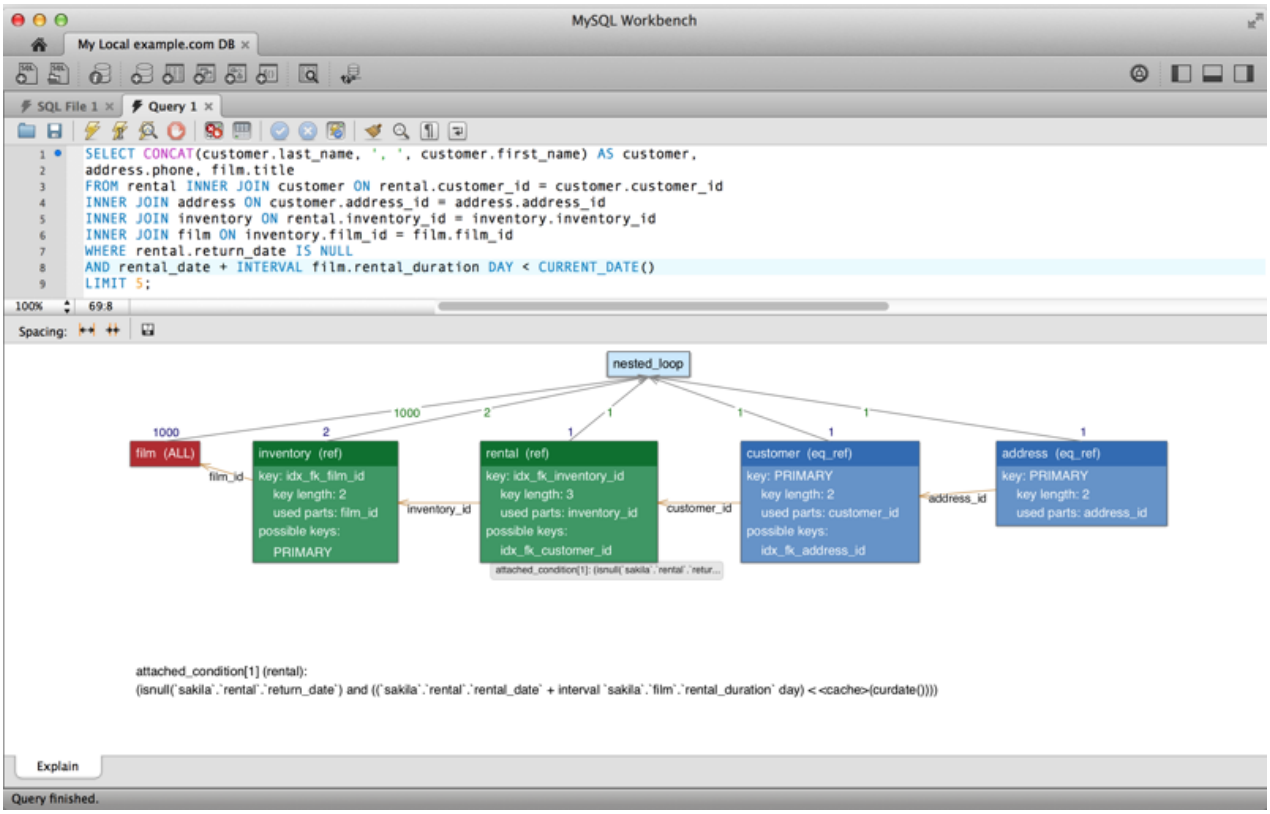


Figure 1.31 Visual Explain: Workbench 6.1

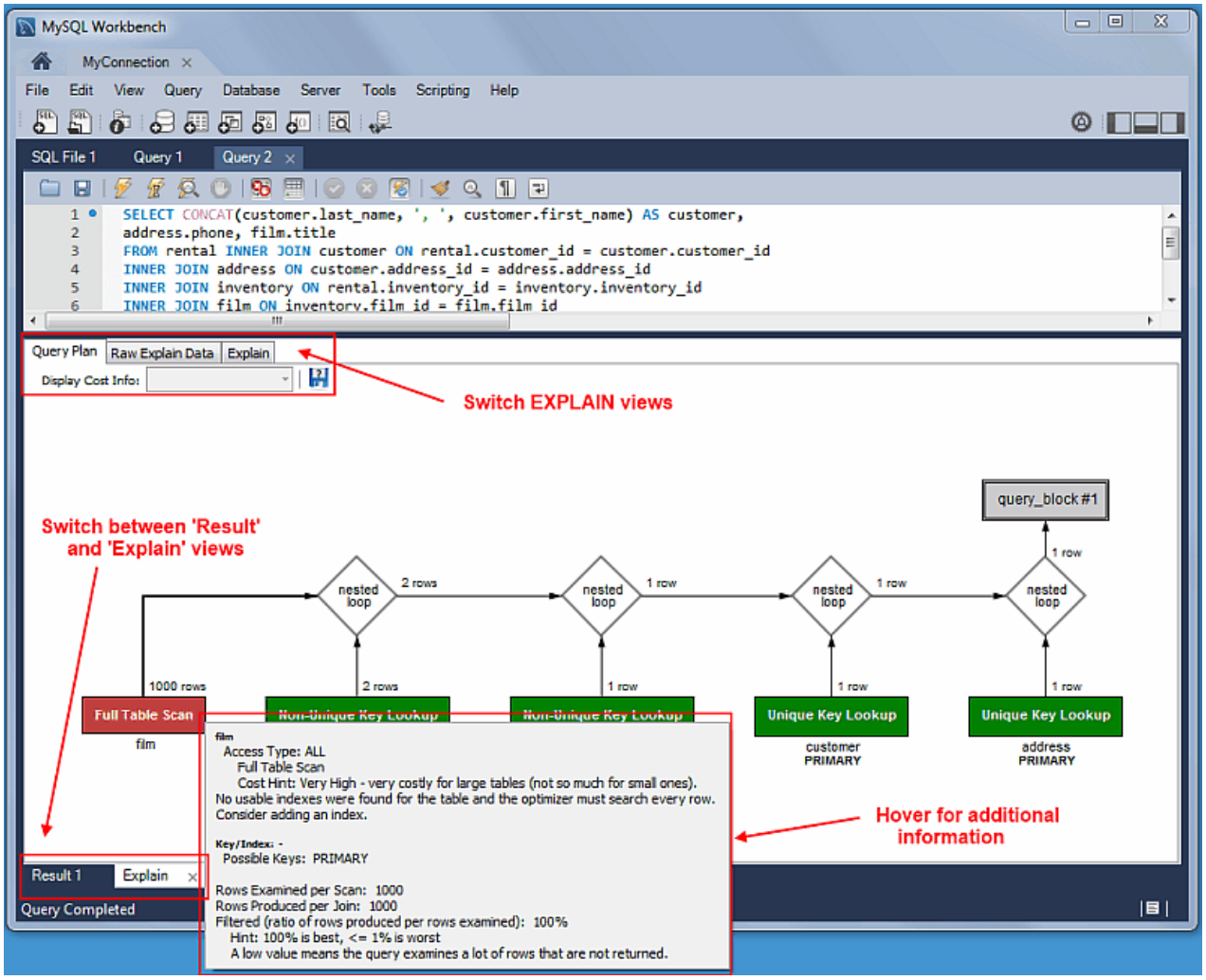
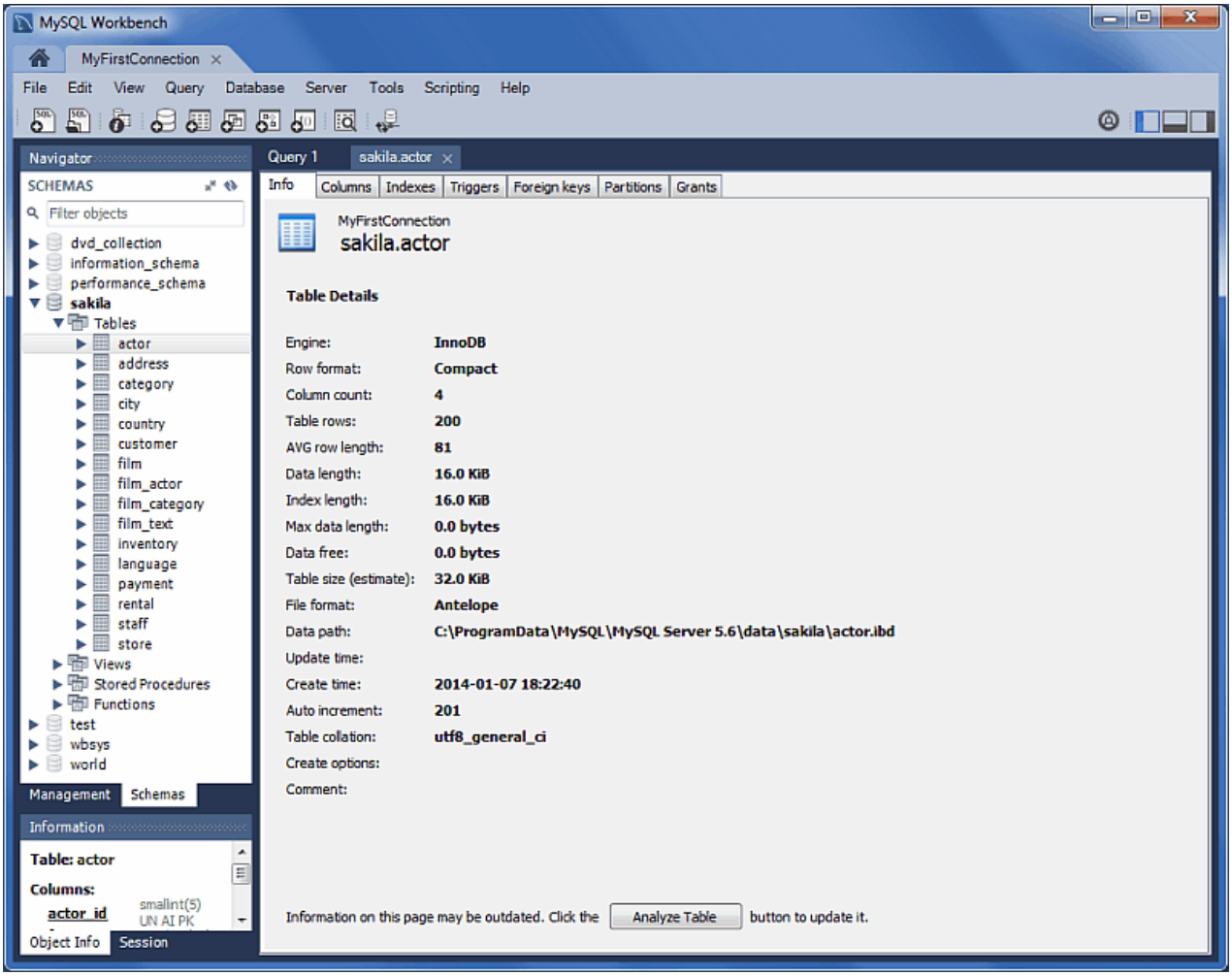

MySQL Workbench
MyConnection
File Edit View Query Database Server Tools Scripting Help
SQL File 1 Query 1 Query 2
SELECT CONCAT(customer.last_name, ', ', customer.first_name) AS customer,
address.phone, film.title
FROM rental INNER JOIN customer ON rental.customer_id = customer.customer_id
INNER JOIN address ON customer.address_id = address.address_id
INNER JOIN inventory ON rental.inventory_id = inventory.inventory_id
INNER JOIN film ON inventory.film_id = film.film_id
Query Plan
Raw Explain Data
Explain
Display Cost Info:
Switch EXPLAIN views
Switch between 'Result' and 'Explain' views
query_block #1
nested loop
2 rows
1 row
1000 rows
Full Table Scan
film
Non-Unique Key Lookup
Unique Key Lookup
customer
PRIMARY
address
PRIMARY
Access Type: ALL
Full Table Scan
Cost Hint: Very High - very costly for large tables (not so much for small ones).
No usable indexes were found for the table and the optimizer must search every row.
Consider adding an index.
Possible Keys: PRIMARY
Rows Examined per Scan: 1000
Rows Produced per Join: 1000
Filtered (ratio of rows produced per rows examined): 100%
Hint: 100% is best, <= 1% is worst
A low value means the query examines a lot of rows that are not returned.
Hover for additional information
Result 1
Explain
Query Completed

Table Inspector

View table information, similar to the Schema Inspector. This also has a simpler and easier to use interface for analyzing and creating indexes for your tables.

Figure 1.32 Table Inspector



Additional Client Connection Information

Additional information was added to the **Client Connections** tab, such as Thread ID, Parent Thread, Instrumented, and Type.

Figure 1.33 Client Connections: MySQL Workbench 6.0

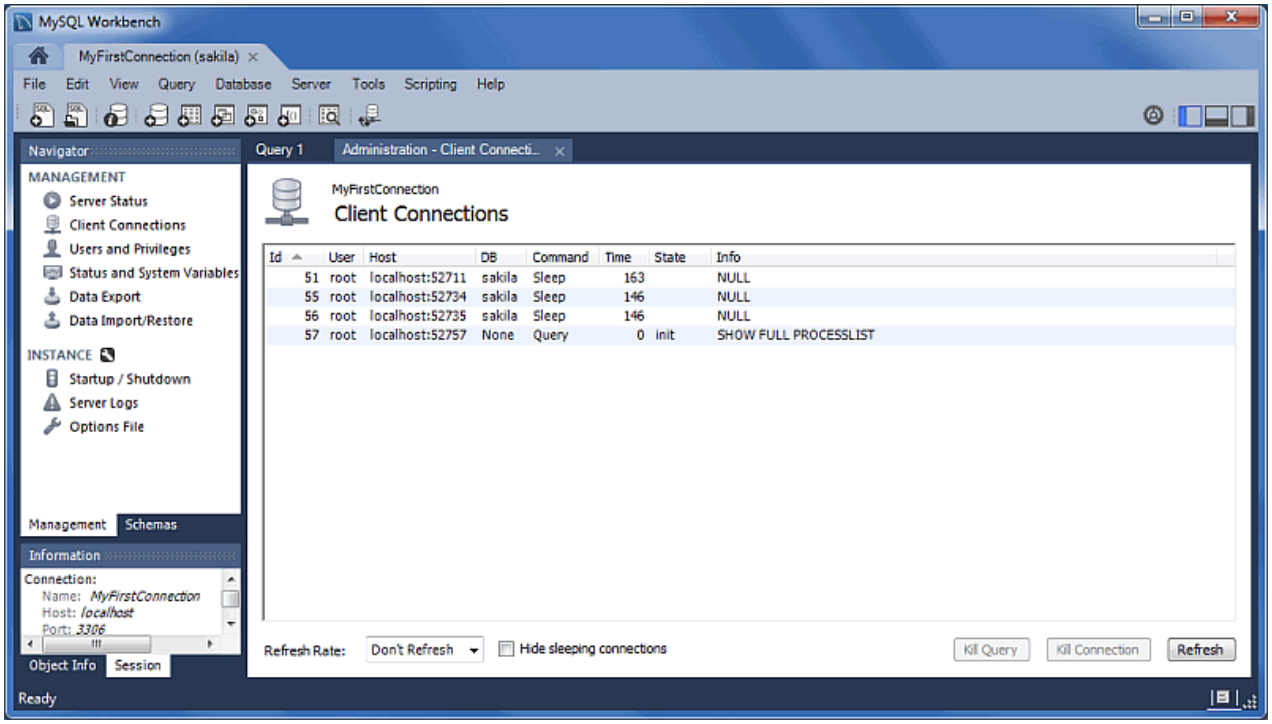
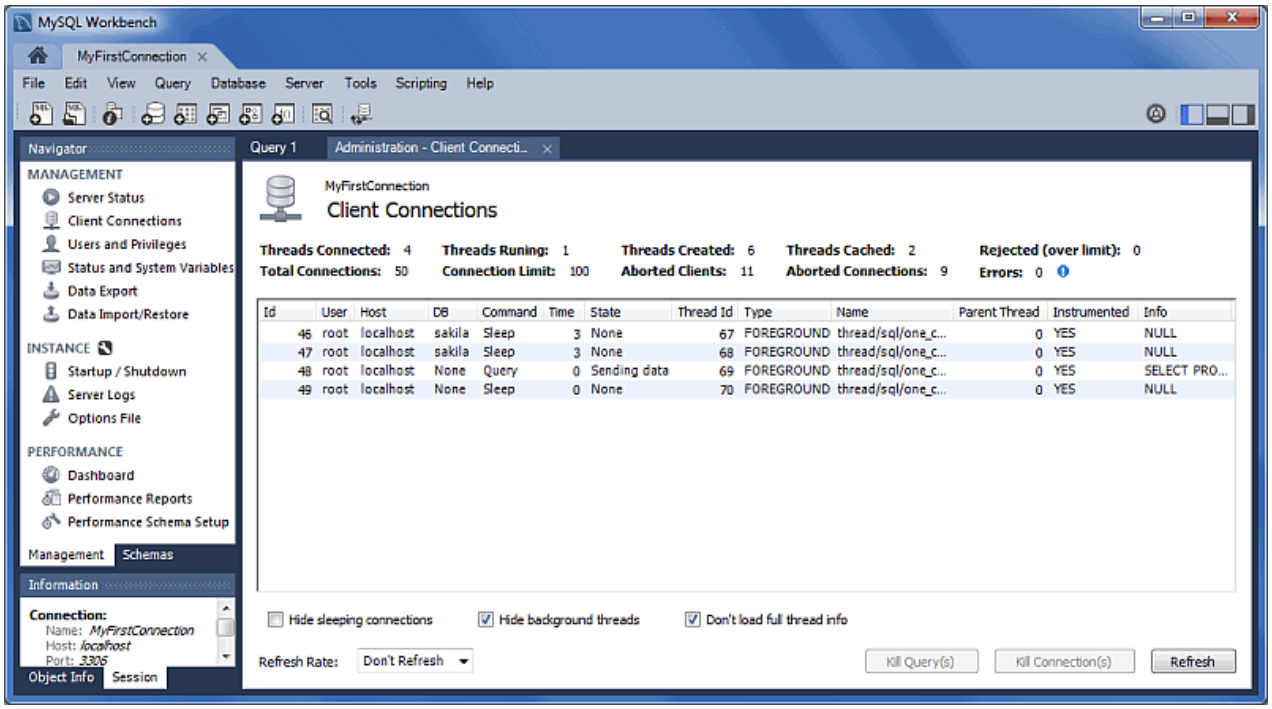
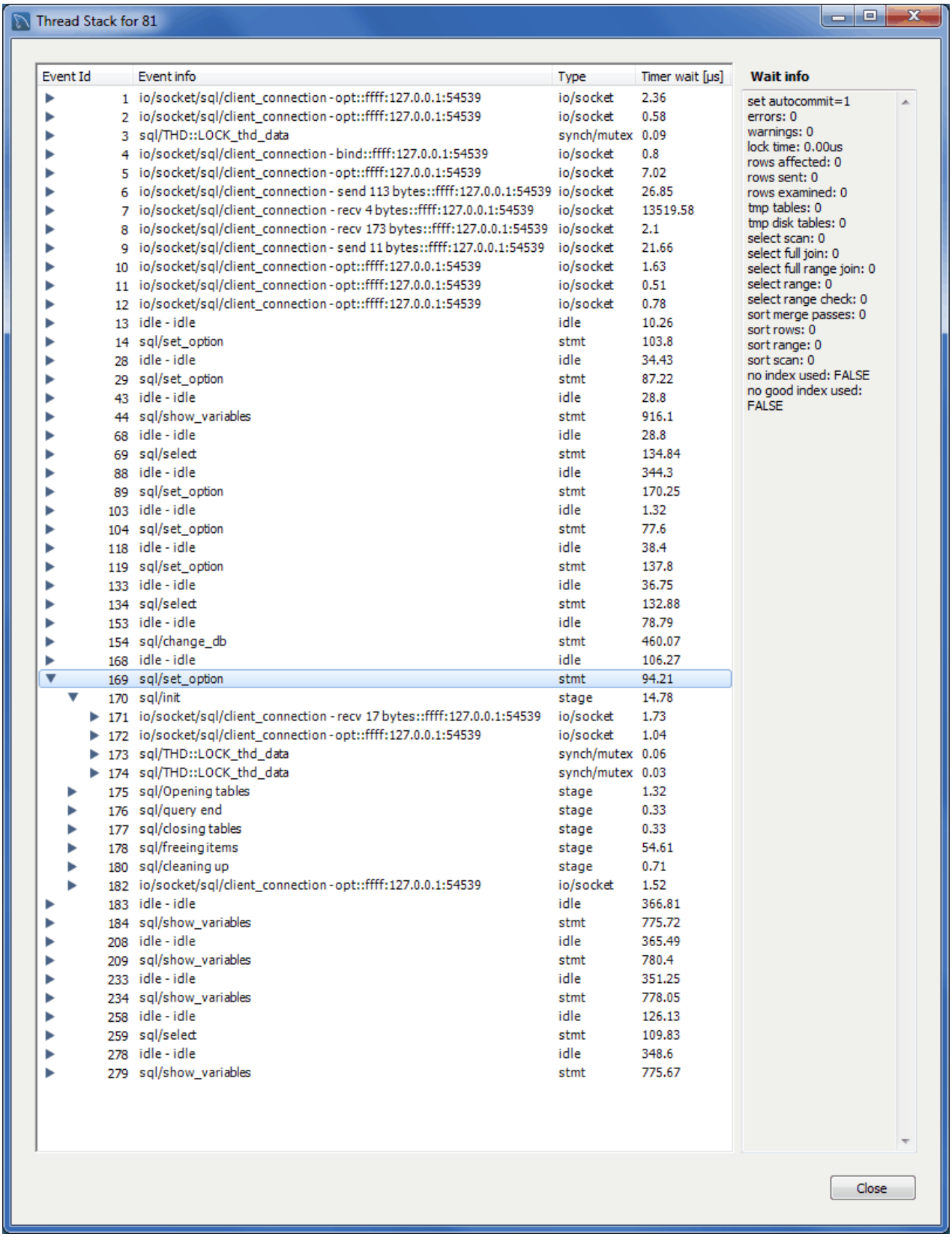


Figure 1.34 Client Connections: MySQL Workbench 6.1



Also, a **Thread Stack** view option was added by right-clicking a connection entry in the **Client Connections** tab and choosing View Thread Stack.

Figure 1.35 Client Connections: View Thread Stack


Thread Stack for 81
Event Id
Event info
Type
Timer wait [µs]
1 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 2.36
2 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 0.58
3 sql/THD::LOCK_thd_data synch/mutex 0.09
4 io/socket/sql/client_connection - bind::ffff:127.0.0.1:54539 io/socket 0.8
5 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 7.02
6 io/socket/sql/client_connection - send 113 bytes::ffff:127.0.0.1:54539 io/socket 26.85
7 io/socket/sql/client_connection - recv 4 bytes::ffff:127.0.0.1:54539 io/socket 13519.58
8 io/socket/sql/client_connection - recv 173 bytes::ffff:127.0.0.1:54539 io/socket 2.1
9 io/socket/sql/client_connection - send 11 bytes::ffff:127.0.0.1:54539 io/socket 21.66
10 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 1.63
11 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 0.51
12 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 0.78
13 idle - idle idle 10.26
14 sql/set_option stmt 103.8
28 idle - idle idle 34.43
29 sql/set_option stmt 87.22
43 idle - idle idle 28.8
44 sql/show_variables stmt 916.1
68 idle - idle idle 28.8
69 sql/select stmt 134.84
88 idle - idle idle 344.3
89 sql/set_option stmt 170.25
103 idle - idle idle 1.32
104 sql/set_option stmt 77.6
118 idle - idle idle 38.4
119 sql/set_option stmt 137.8
133 idle - idle idle 36.75
134 sql/select stmt 132.88
153 idle - idle idle 78.79
154 sql/change_db stmt 460.07
168 idle - idle idle 106.27
169 sql/set_option stmt 94.21
170 sql/init stage 14.78
171 io/socket/sql/client_connection - recv 17 bytes::ffff:127.0.0.1:54539 io/socket 1.73
172 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 1.04
173 sql/THD::LOCK_thd_data synch/mutex 0.06
174 sql/THD::LOCK_thd_data synch/mutex 0.03
175 sql/Opening tables stage 1.32
176 sql/query end stage 0.33
177 sql/closing tables stage 0.33
178 sql/freeing items stage 54.61
180 sql/cleaning up stage 0.71
182 io/socket/sql/client_connection - opt::ffff:127.0.0.1:54539 io/socket 1.52
183 idle - idle idle 366.81
184 sql/show_variables stmt 775.72
208 idle - idle idle 365.49
209 sql/show_variables stmt 780.4
233 idle - idle idle 351.25
234 sql/show_variables stmt 778.05
258 idle - idle idle 126.13
259 sql/select stmt 109.83
278 idle - idle idle 348.6
279 sql/show_variables stmt 775.67
Wait info
set autocommit=1
errors: 0
warnings: 0
lock time: 0.00us
rows affected: 0
rows sent: 0
rows examined: 0
tmp tables: 0
tmp disk tables: 0
select scan: 0
select full join: 0
select full range join: 0
select range: 0
select range check: 0
sort merge passes: 0
sort rows: 0
sort range: 0
sort scan: 0
no index used: FALSE
no good index used: FALSE
Close

Additional Miscellaneous Additions

- MSAA (Windows Accessibility API) support and High contrast color theme in Microsoft Windows
- MySQL Enterprise Backup improvements
- Improvements with general performance and overall stability

1.1.4 New in MySQL Workbench 6.0

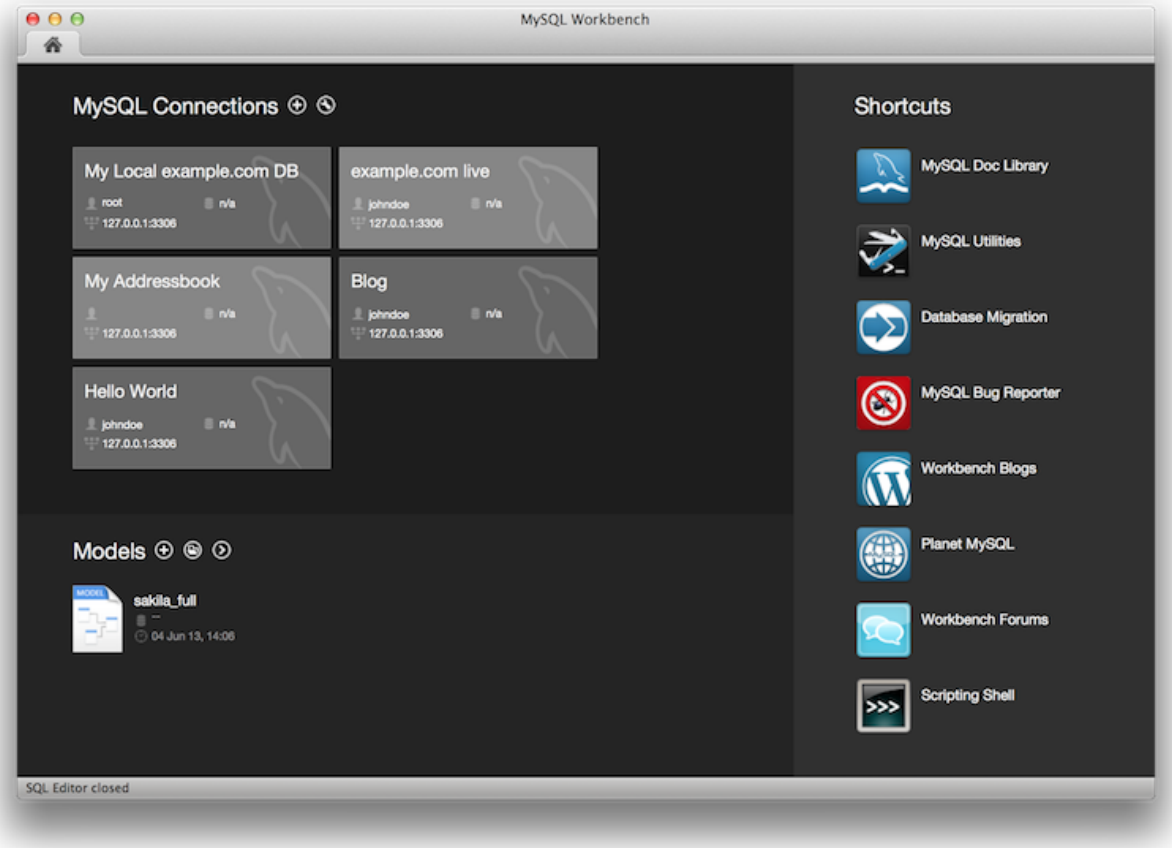
This section summarizes many of the new features added to MySQL Workbench 6.0.0, in relation to MySQL Workbench 5.2.x;.

A new home screen

A new, modernized Home screen where major functionality of MySQL Workbench can be accessed, including connections to MySQL servers, modeling, migration, and the command-line utilities.

Figure 1.36 Home Screen: Workbench 5.2

Figure 1.37 Home Screen: Workbench 6.0



Unified SQL Editor and Administration interface

In the new user interface, the Server Administration functionality (such as start/stop server, managing user accounts etc) is now accessible directly from the SQL Editor interface, located near where the schema information can be browsed and queries executed.

The image below contains three screenshots of the Schema window in the SQL Editor. The first is from MySQL Workbench 5.2, the second is MySQL Workbench 6.0 with the management tab collapsed, and the third shows what the merged management tab looks like. Toggle the merged and tabbed views by clicking the new merge button next to the refresh button.

Figure 1.38 Comparing the SQL Editor interface for Workbench 5.2 and 6.0

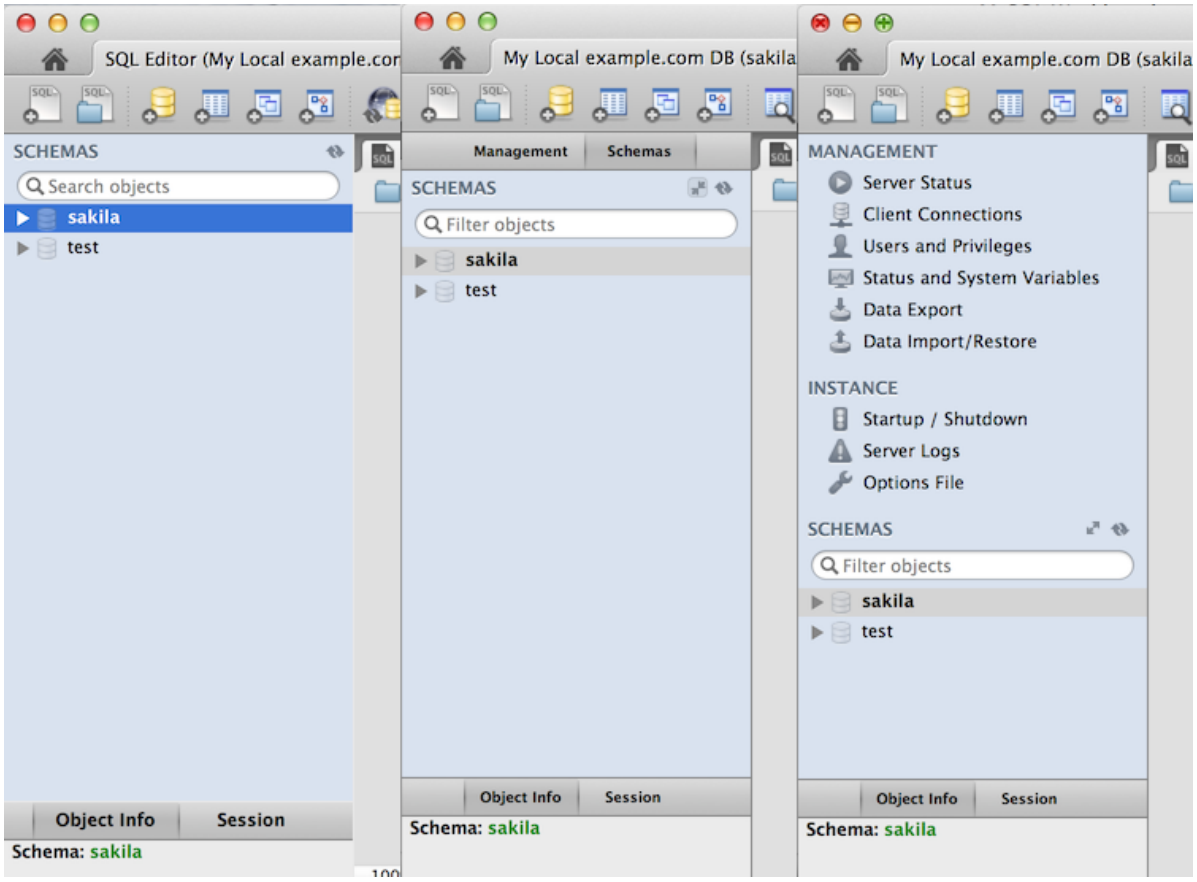
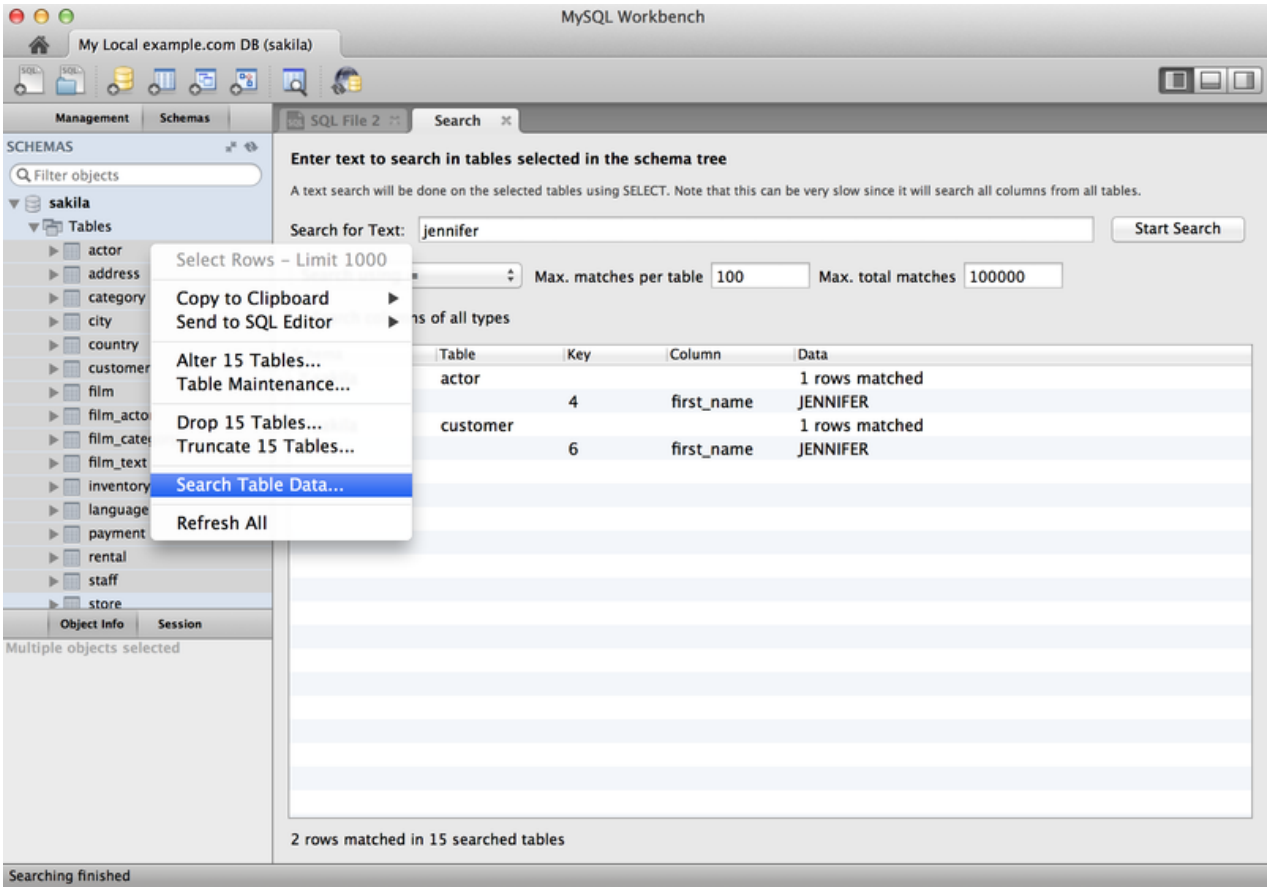


Table data search

You can select schemas and/or tables to perform client-side searches for user specified strings and patterns. To access this new search feature, right click select a schema or a table in the left sidebar and select Search Table Data....

This screenshot demonstrates the search feature, along with an example search. Multiple tables were selected and searched in this example:

Figure 1.39 Table search functionality

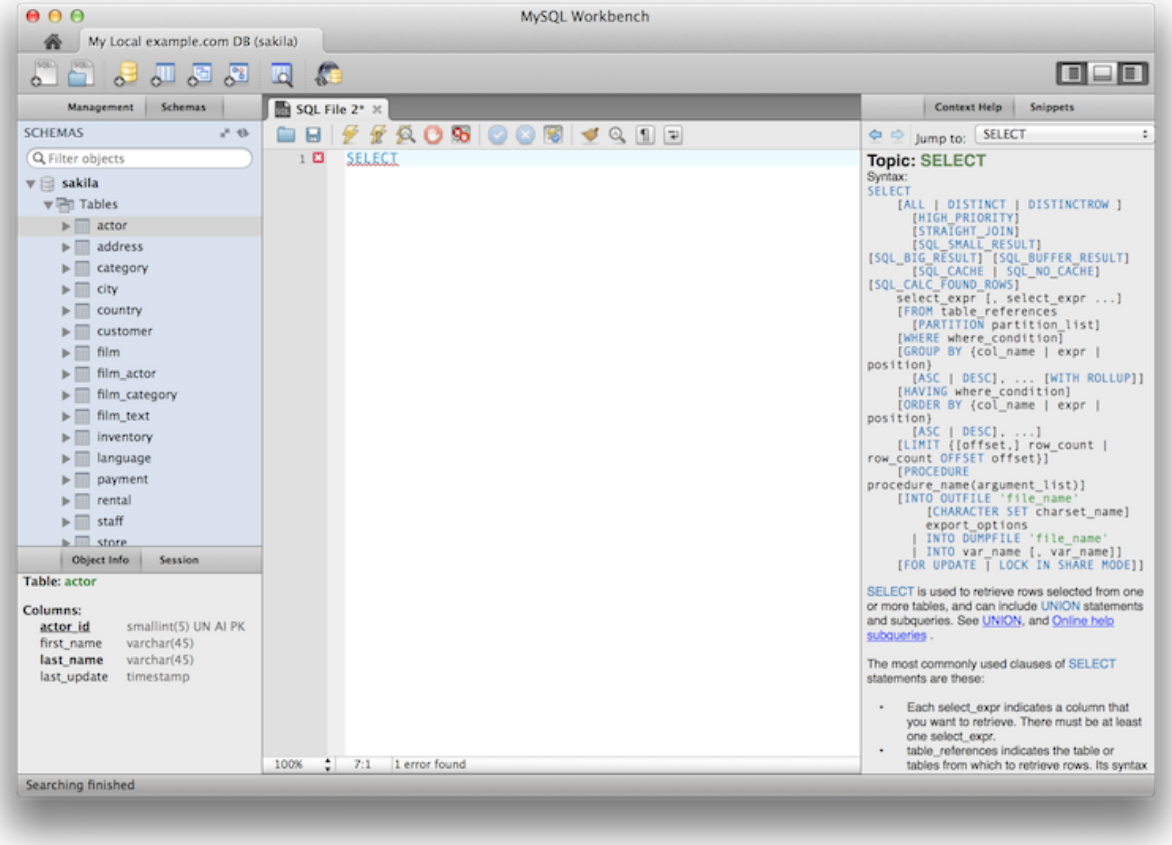


For additional information, see Section 8.1.8, “Table Data Search Panel”.

Context Sensitive help for the SQL Editor

Select a keyword or function in your query and after a delay it will show formatted help information from the MySQL Server (equivalent to using the help command from the command-line MySQL Client).

Figure 1.40 Context Sensitive Help

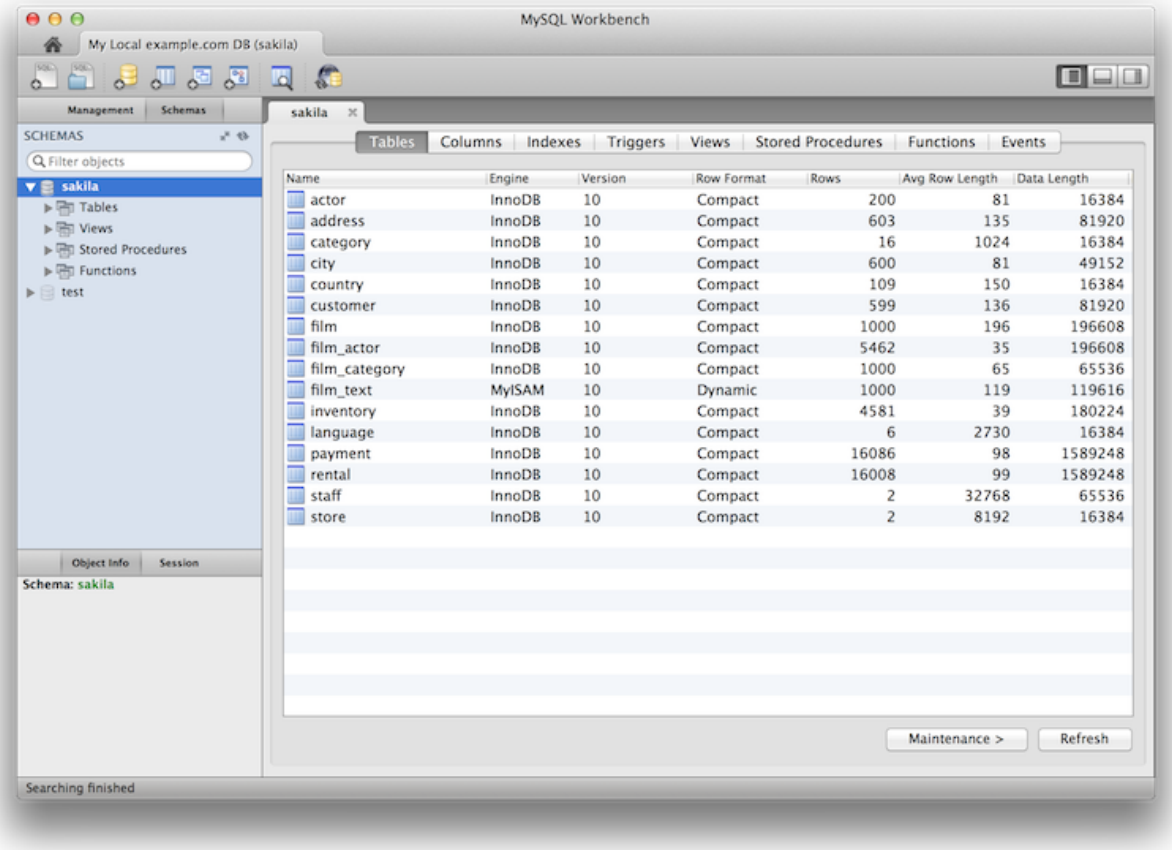


For additional information, see Section 8.1.6, “Context Sensitive Help”.

Schema Inspector

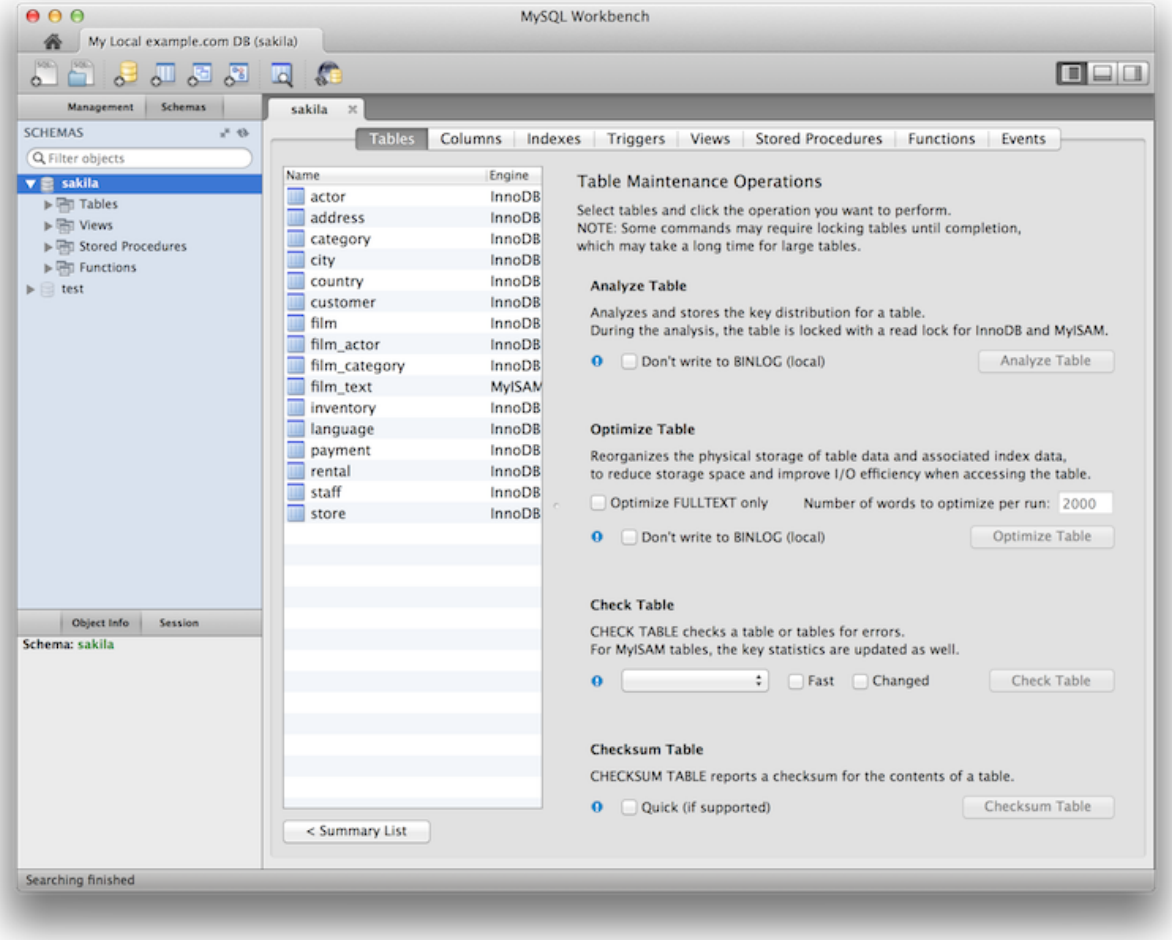
New Schema Inspector feature allows you to browse general information from schema objects. For tables, it's also possible to perform maintenance tasks such as `ANALYZE`, `OPTIMIZE`, `CHECK`, and `CHECKSUM TABLE`. To access the inspector, right-click a schema and select the Schema Inspector

Figure 1.41 Schema Inspector



And choosing Maintenance for a table:

Figure 1.42 Schema Inspector: Maintenance



For additional information, see Schema Inspector.

Cascaded DELETE statements generator

You can generate a series of `DELETE` statements needed to delete a row from that table, which includes rows from other tables that reference it, recursively. The `SELECT` version allows you to preview what rows would be deleted. Right click a table and select Copy to Clipboard, Delete with References.

Figure 1.43 Cascading SELECT

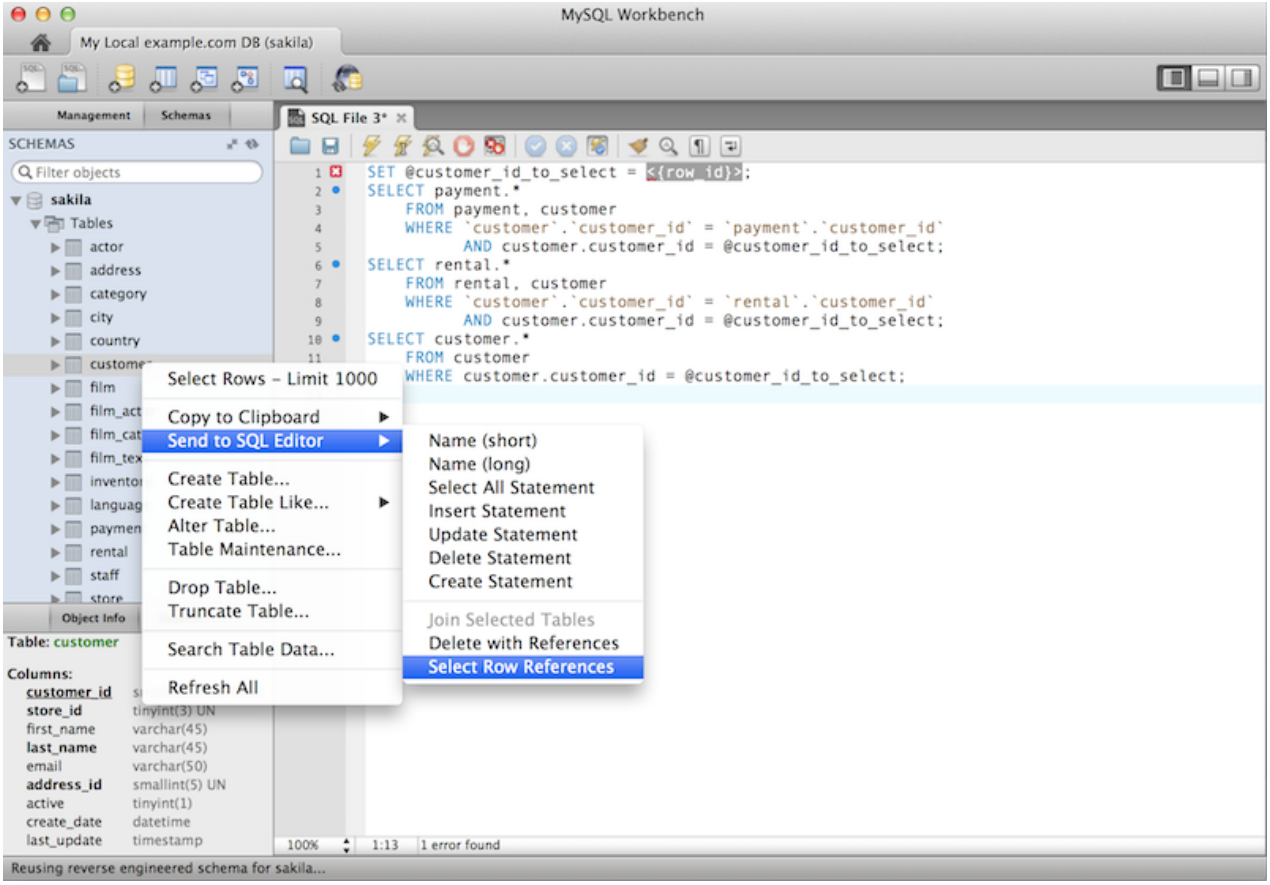


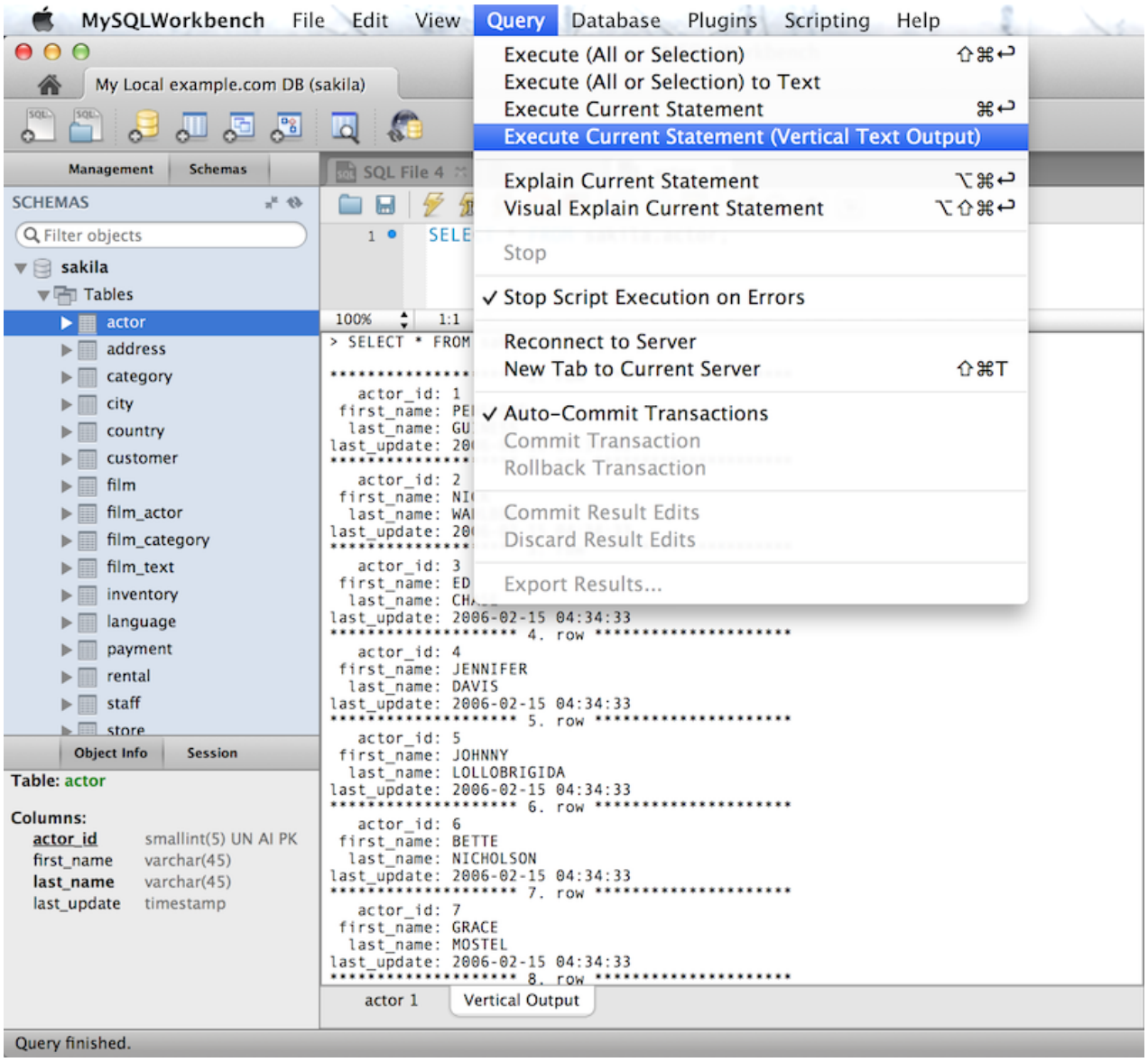
Table templates

Define templates of tables with commonly used columns, to be used to create new tables in a live connection or in an EER model. In the SQL Editor, choose **Create Table Like...**, or in Modeling, use the right sidebar. For additional information, see Section 9.6, “Table Templates”.

Vertical Text

A Vertical Text output option for queries (equivalent to \G from the command-line Client) was added. To execute, choose Query, Execute Current Statement (Vertical Text Output).

Figure 1.44 Vertical Text (\G)



Improved Visual Explain

The Visual Explain output was improved.

Figure 1.45 Visual Explain: Workbench 5.2

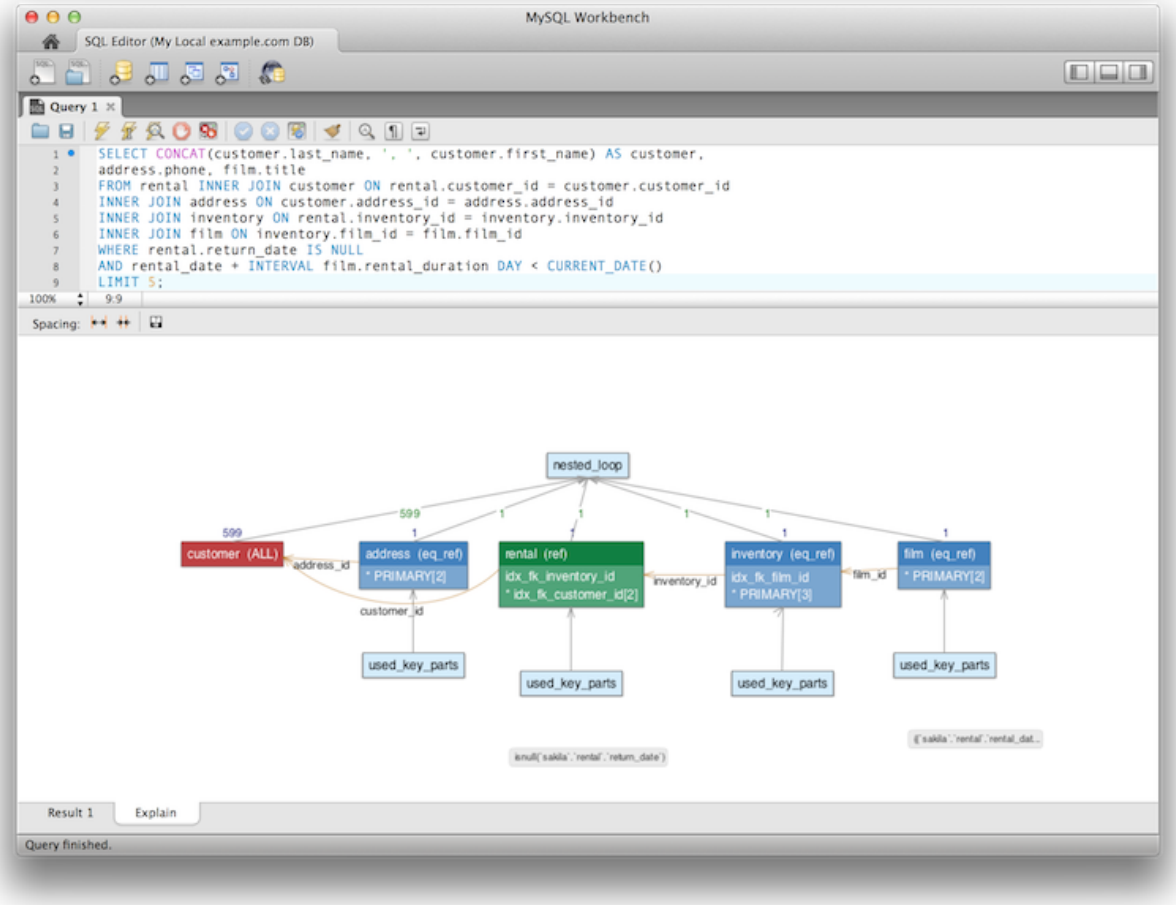
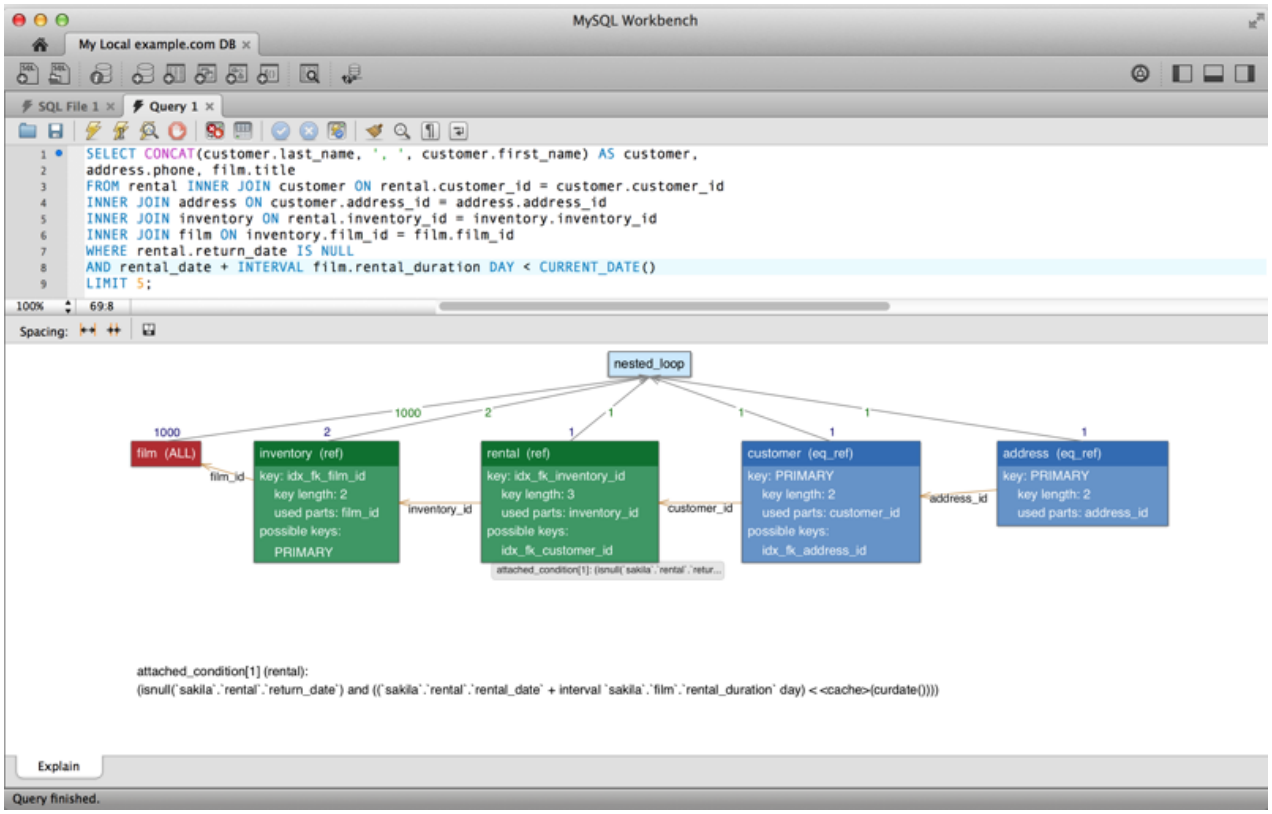


Figure 1.46 Visual Explain: Workbench 6.0



Improved Server Status

Additional server status information was added, and the user interface was improved. Select **Server Status** from the **Management** tab to open this window.

Figure 1.47 Server Status: Workbench 5.2

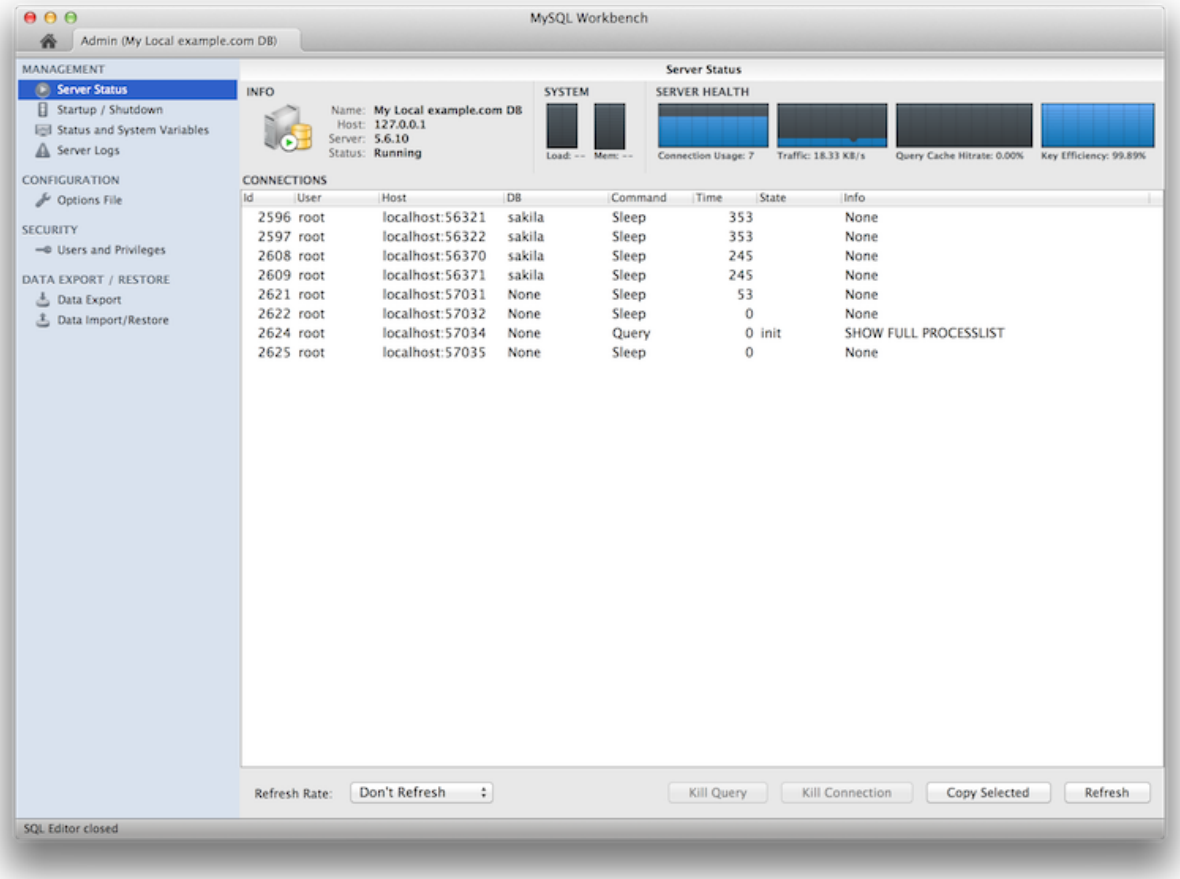
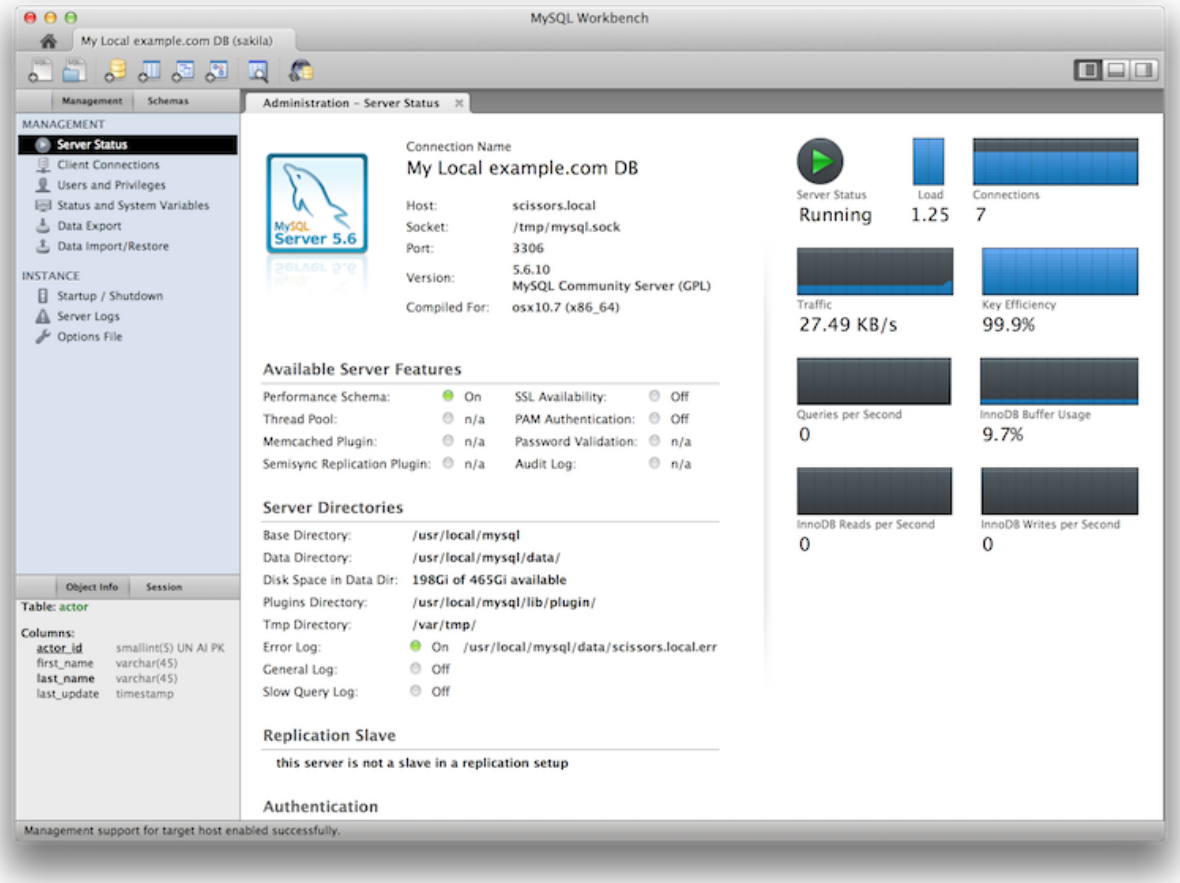


Figure 1.48 Server Status: Workbench 6.0



Enterprise Features

Support for MySQL Enterprise features in the Commercial edition of MySQL Workbench was added. From within the **Management** tab for an open connection, look for the following products under the heading **MySQL Enterprise**:

`MySQL Enterprise Backup (MEB)`: A GUI frontend for the MEB tool. After installing a commercial version of MySQL Workbench and MySQL Enterprise Backup, MySQL Workbench will check for and handle the pre-requisites. Backup recovery is also supported. This plugin supports MEB with local and remote installations of Linux and OS X, and locally for MySQL Windows.

`MySQL Audit Log Inspector`: A GUI for browsing the contents of generated logs by the commercial Audit Log Plugin. Powerful filtering and search capabilities are available. Fast browsing is provided by caching the log data locally in an encrypted file. This plugin supports MEB with local and remote installations of Linux and OS X, and locally for MySQL Windows.

Database Migration Features

SQL Anywhere and SQLite are now supported.

1.2 MySQL Workbench Editions

MySQL Workbench is available in the following editions:

- `Community Edition` (Open Source, GPL) -- This is the foundation for all other editions
- `Standard Edition` (Commercial)
- `Enterprise Edition` (Commercial)

For details about each edition, see http://www.mysql.com/products/workbench/features.html

For more information about the Enterprise edition, visit http://www.mysql.com/enterprise

Chapter 2 Installation

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MySQL Workbench is available for Windows, Linux, and OS X.

Binary distributions of MySQL Workbench are available for the preceding platforms. Source code distributions are also available as a `tar.gz` package, or an RPM package.

MySQL Workbench downloads are available at http://dev.mysql.com/downloads/workbench/. The source code is also available on GitHub.

The following sections explain the installation process for each of these platforms.

2.1 System Requirements

MySQL Workbench is available on a number of operating systems and platforms. For information about those platforms that are officially supported, see http://www.mysql.com/support/supportedplatforms/workbench.html on the MySQL Web site.

General Requirements

General requirements and considerations that apply to all operating systems.

- **MySQL server**: Although it is not required, MySQL Workbench is designed to have either a remote or local MySQL server connection. For additional information about connecting to a MySQL server, see Chapter 5, *MySQL Connections*. For additional information about installing a MySQL server, see Installing and Upgrading MySQL.

  Data modeling does not require a MySQL server connection.

- **Simultaneous client connections**: Opening a MySQL connection from the MySQL Workbench home page opens a new connection tab in MySQL Workbench for that connection. Each of these tabs requires two MySQL connections to perform basic tasks, such schema discovery and SQL execution. Additionally, performing management related tasks, such as **Server Status**, requires two additional MySQL connections. Essentially, this means that each MySQL connection tab in MySQL Workbench requires four available connections to MySQL. For additional information about "Too many connection" related errors, see Too many connections.

This connection requirement doubles with each connection tab opened in MySQL Workbench, even if the two connection tabs point to the same MySQL server. SQL editor tabs share their connections, so having multiple SQL editor and SQL results tabs does not affect the number of required connections.

Note

On startup, the application checks the OpenGL version and chooses between software and hardware rendering. To determine which rendering method is being used, open the Help menu and choose the System Info item.

Requirements for Linux

- The requirements for Linux are embedded within their respective packages. Use the platform specific tool (for example, yum or apt) to install the package and their dependencies.
- The "Save password in keychain" functionality requires `gnome-keyring` to store the passwords. Note that on KDE systems, the `gnome-keyring` daemon is not started by default.
- For Linux and OS X, the MySQL server administration features require `sudo` privileges to execute several commands. The sudo user must be capable of executing the following system commands:

```
/usr/bin/sudo
/usr/bin/nohup
/usr/bin/uptime
/usr/bin/which
/usr/bin/stat

/bin/bash
/bin/mkdir
/bin/rm
/bin/rmdir
/bin/dd
/bin/cp
/bin/ls
```

Additionally, the sudo user must keep the `HOME` environment variable when executing system commands, which means adding the following to `/etc/sudoers`:

```
env_keep +="HOME"
```

For MySQL Workbench to execute MySQL Enterprise Backup commands, the sudo user must also be able to execute the MySQL Enterprise Backup binary.

Requirements for Windows

- Microsoft .NET 4.0 Framework
- Microsoft Visual C++ 2013 Redistributable Package (MSVC2013)

Note

The 2010 version was used in previous editions of MySQL Workbench 6.

- Windows 7 and above

Note

MySQL Workbench 6.1 supports earlier versions of Windows, including Vista

2.2 Command-line options

In addition to platform-specific command-line options, MySQL Workbench has the following command-line options:

Note

On Microsoft Windows, the command-line options contain one leading dash instead of two. For example, use `-log-level` for Microsoft Windows and `--log-level` for Linux and OS X.

- `--log-level` *`level`*: Controls the verbosity level for logging output from Workbench.

  With increasingly levels of verbosity, the valid values for `level` are: error, warning, info, debug1, debug2, and debug3.

  The location of the generated log files, such as `wb.log`, are as follows:

  Table 2.1 The default location of generated MySQL Workbench log files

Platform	Default location
Linux	`~/.mysql/workbench/log/`
OS X	`~/Library/Application Support/Workbench/log/`
Microsoft Windows	`C:\Users\`*`user_name`*`AppData\Roaming\MySQL\Workbench\log\`

- `--admin` *`instance`*: Open an administration tab to the named MySQL instance.
- `--upgrade-mysql-dbs`: Open the Migration Wizard tab.
- `--migration`: Open the Migration Wizard tab.
- `--log-to-stderr`: Also log to `stderr`.
- `--version`: Show MySQL Workbench version number and exit.
- `--verbose, -v`: Enable diagnostics output.
- `--query` *`[connection|connection_string]`*:
  - Empty: Open a query tab and prompts for a connection.
  - Connection: Open a named connection.
  - Connection_string: Create a connection based on the entered connection string, which should be in the form *`$USER@$HOST:$PORT`*.
- `--model` *`modelfile`*: open the given EER model file.
- `--script` *`script`*: Open the given SQL file in a connection, typically used with the `--query` parameter.

- `--run code`: Execute the given code using the default language for GRT shell.
- `--run-python script`: Execute the given code in Python.
- `--run-script file`: Execute Python code from a file.
- `--open file`: Open the given file at startup. Deprecated, so instead use specific types such as `--script` or `--model`.
- `--quit-when-done`: Quits MySQL Workbench after `--script` or `--run` finishes.

2.3 MySQL Workbench on Windows

2.3.1 Installing

MySQL Workbench for Windows can be installed using the MySQL Installer that installs and updates all MySQL products on Windows, the standalone .msi installation package, or manually from a Zip file.

Important

Installing MySQL Workbench using an Installer package requires either Administrator or Power User privileges. If you are using the Zip file without an installer, you do not need Administrator or Power User privileges.

Requirements for Windows

- Microsoft .NET 4.0 Framework
- Microsoft Visual C++ 2013 Redistributable Package (MSVC2013)

Note

The 2010 version was used in previous editions of MySQL Workbench 6.

- Windows 7 and above

Note

MySQL Workbench 6.1 supports earlier versions of Windows, including Vista

Installation Using MySQL Installer

The general MySQL Installer download is available at http://dev.mysql.com/downloads/windows/installer/. The MySQL Installer application can install, upgrade, and manage most MySQL products, including MySQL Workbench.

This is the Recommended Approach

Managing all of your MySQL products, including Workbench, with MySQL Installer is the recommended approach. It handles all requirements and prerequisites, configurations, and upgrades.

When executing MySQL Installer, you may choose MySQL Workbench as one of the products to install. It is selected by default, and essentially executes the standalone Installer Package described below.

Installation Using the Installer Package

The standalone download is available at http://dev.mysql.com/downloads/workbench/.

MySQL Workbench can be installed using the Windows Installer (`.msi`) installation package. The MSI package bears the name `mysql-workbench-community-version-winarch.msi`, where *`version`* indicates the MySQL Workbench version number, and *`arch`* the build architecture (either win32 or winx64).

1. To install MySQL Workbench, right-click the MSI file and select the Install item from the pop-up menu, or double-click the file.

2. In the **Setup Type** window you may choose a `Complete` or `Custom` installation. To use all features of MySQL Workbench choose the `Complete` option.

3. Unless you choose otherwise, MySQL Workbench is installed in `C:\%PROGRAMFILES%\MySQL \MySQL Workbench 6.3 edition_type\`, where *`%PROGRAMFILES%`* is the default directory for programs for your locale. The `%PROGRAMFILES%` directory is defined as `C:\Program Files\` on most systems.

Installation Using the Zip File

If you have problems running the Installer package, an alternative is to install from a Zip file without an installer. That file is called `mysql-workbench-community-version-arch.zip`, where *`version`* indicates the MySQL Workbench version number, and *`arch`* the build architecture (either win32 or winx64).

To install using the Zip file, download the Zip file to a convenient location and decompress the file using a Zip utility. You can place the resulting directory anywhere on you system. You need not install or configure the application before using it. You may want to create a shortcut on your desktop or the quick launch bar.

2.3.2 Launching

To start MySQL Workbench on Windows, select Start, Programs, MySQL, then select MySQL Workbench. This executes the `MySQLWorkbench.exe` file on your system.

Alternatively, start MySQL Workbench from the command line. To view the available command-line options, issue the command `MySQLWorkbench -help` from the MySQL Workbench installation directory. You will see the following output:

```
MySQLWorkbench.exe [<options>] [<name of a model file or sql script>]

Options:
  -swrendering           Force the diagram canvas to use software rendering instead of OpenGL
  -query [<connection>|<connection string>]
                         Open a query tab and ask for connection if nothing is specified.
                         If named connection is specified it will be opened, else connection
                         will be created based on the given connection string, which should
                         be in form <user>@<host>:<port>
  -admin <instance>      Open a administration tab to the named instance
  -upgrade-mysql-dbs     Open a migration wizard tab
  -model <model file>    Open the given EER model file
  -script <sql file>     Open the given SQL file in an connection, best in conjunction with
                         a query parameter
  -run-script <file>     Execute Python code from a file
  -run <code>            Execute the given Python code
  -run-python <code>     Execute the given Python code
  -migration             Open the Migration Wizard tab
  -quit-when-done        Quit Workbench when the script is done
  -log-to-stderr         Also log to stderr
  -help, -h              Show command line options and exit
  -log-level=<level>     Valid levels are: error, warning, info, debug1, debug2, debug3
  -verbose, -v           Enable diagnostics output
  -version               Show Workbench version number and exit
```

```
-open <file>           Open the given file at startup (deprecated, use script, model etc.)
```

Use the `-swrendering` option if your video card does not support OpenGL 1.5. The `-version` option can be used to display the MySQL Workbench version number. The other options are self-explanatory.

MySQL Workbench may also be started from MySQL Notifier by choosing SQL Editor or Configure Instance from the Notifier context menu. For additional information, see MySQL Notifier.

2.3.3 Uninstalling

The method for uninstalling MySQL Workbench depends on how you installed MySQL Workbench.

Removing MySQL Workbench After Installation Using the Installer Package

1. To uninstall MySQL Workbench, open the **Control Panel** and Choose **Add or Remove Programs**. Find the MySQL Workbench entry and choose the Remove button. This will remove MySQL Workbench.

Note

If you installed MySQL Workbench using the Installer package, it is not possible to remove MySQL Workbench from the command line. Although you can manually remove some of the components, there is no command-line option for removing MySQL Workbench.

Removing the MySQL Workbench directory manually will not remove all the files belonging to MySQL Workbench.

Removing MySQL Workbench After Installation from the MySQL Installer

Open the MySQL Installer for Windows, click **Remove MySQL Products**, choose MySQL Workbench, and then Execute.

What Is Not Removed

The uninstallation process does not remove your MySQL Workbench configuration directory. This directory includes your MySQL connections, configuration settings, cache files, SQL snippets and history, logs, custom modules, and more. These files are stored under your user's `%AppData%` directory.

Note

By default, the MySQL Workbench configuration directory is `C:\username\AppData\Roaming\MySQL\Workbench\` where "C:\username\AppData\Roaming\" is the value of your `%AppData%` Windows system variable.

Also, the uninstallation process does not remove the `.mysqlworkbench` schema that MySQL Workbench creates when sharing SQL snippets across a MySQL connection. For additional information about shared snippets, see Section 8.1.5, “SQL Snippets tab”.

2.4 MySQL Workbench on Linux

2.4.1 Installing

There are binary distributions of MySQL Workbench available for several variants of Linux, including Fedora, Oracle Linux, and Ubuntu.

Installation options include:

- **Official MySQL Yum or APT repository packages**: These binaries are built by the MySQL Release team. For additional information about installing these, see Yum or APT. They contain the newest versions of MySQL Workbench. Typically this package is named `mysql-workbench-community`.
- **Your Linux distributions repository packages**: These binaries are built and maintained by members of the Linux distribution you use, and not by the MySQL team. They are stable but the releases often lag behind. Typically this package is named `mysql-workbench`.
- **Download official MySQL packages**: Downloads are available at http://dev.mysql.com/downloads/workbench.
- **Download the source code and compile yourself**: The source code is available at http://dev.mysql.com/downloads/workbench as a `tar.gz` or RPM package.

Note

32-bit binary builds are not available as of MySQL Workbench 6.2.0. You can use the source code to build your own 32-bit version, as needed.

The procedure for installing on Linux depends on which Linux distribution you are using.

Requirements for Linux

- The requirements for Linux are embedded within their respective packages. Use the platform specific tool (for example, yum or apt) to install the package and their dependencies.
- The "Save password in keychain" functionality requires `gnome-keyring` to store the passwords. Note that on KDE systems, the `gnome-keyring` daemon is not started by default.
- For Linux and OS X, the MySQL server administration features require `sudo` privileges to execute several commands. The sudo user must be capable of executing the following system commands:

```
/usr/bin/sudo
/usr/bin/nohup
/usr/bin/uptime
/usr/bin/which
/usr/bin/stat

/bin/bash
/bin/mkdir
/bin/rm
/bin/rmdir
/bin/dd
/bin/cp
/bin/ls
```

Additionally, the sudo user must keep the `HOME` environment variable when executing system commands, which means adding the following to `/etc/sudoers`:

```
env_keep +="HOME"
```

For MySQL Workbench to execute MySQL Enterprise Backup commands, the sudo user must also be able to execute the MySQL Enterprise Backup binary.

Installing DEB packages

On Ubuntu, and other systems that use the Debian package scheme, you can either download and install .deb packages or use the APT package manager.

Using the APT Package Manager

Important

Your Linux distribution includes MySQL Workbench builds where "apt-get install mysql-workbench" will install their build of the MySQL Workbench package. To use the official MySQL Workbench builds as provided by the MySQL Release team, you must install the official MySQL APT repository and choose the "mysql-workbench-community" package instead of "mysql-workbench".

- First, install the MySQL APT repository as described in the MySQL APT Repository documentation. For example:

```
shell> sudo dpkg -i mysql-apt-config_0.5.3-1_all.deb
shell> sudo apt-get update
```

- Next, install MySQL Workbench. You might have multiple Workbench packages available, so choose the "mysql-workbench-community" version. For example:

```
shell> sudo apt-get install mysql-workbench-community
```

Manually Installing a Package

You install MySQL Workbench using a command such as:

```
shell> sudo dpkg -i package.deb
```

package`.deb` is the MySQL Workbench package name; for example, `mysql-workbench-community-`*version*`1ubu1404-amd64.deb`, where *version* is the MySQL Workbench version number.

Note

You may be warned that certain libraries are not available, depending on what you already have installed. Install the required libraries and then install the MySQL Workbench package again.

Installing RPM packages

On Red Hat-based systems, and other systems that use the RPM package format, you can either download and install RPM packages or use the Yum package manager.

Note

Enterprise Linux systems, such as Oracle Linux and Red Hat, require access to the EPEL package repository. For additional information about installing EPEL, see Installing Oracle Enterprise Linux and similar.

Using the Yum Package Manager

Your Linux distribution includes MySQL Workbench builds where "yum install mysql-workbench" will install their build of the MySQL Workbench package. To use the official MySQL Workbench builds as provided by the MySQL Release team, you must install the official MySQL Yum repository and choose the "mysql-workbench-community" package instead of "mysql-workbench".

- First, install the MySQL Yum repository as described in the MySQL Yum Repository documentation. For example:

```
shell> sudo rpm -Uvh mysql-community-release-el7-7.noarch.rpm
```

- Next, install MySQL Workbench. You might have multiple Workbench packages available, so choose the "mysql-workbench-community" version. For example:

```
shell> sudo yum install mysql-workbench-community
```

Manually Installing a Package

```
shell> sudo rpm -i package.rpm
```

package`.rpm` is the MySQL Workbench package name; for example, `mysql-workbench-community-`*version*`-1fc10.x86_64.rpm`, where *version* is the MySQL Workbench version number.

Installing Oracle Enterprise Linux and similar

MySQL Workbench requires access to the EPEL repository. EPEL is a repository with additional RPM packages that are not part of the core RHEL/OEL distribution. This includes packages (such as tinyxml) that MySQL Workbench requires.

You need to set up the EPEL repository in yum to resolve the required dependencies. For example, using Oracle Linux 6.5 you would:

```
shell> wget http://download.fedoraproject.org/pub/epel/6/i386/epel-release-6-8.noarch.rpm
shell> rpm -ivh epel-release-6-8.noarch.rpm

shell> yum repolist

Loaded plugins: refresh-packagekit, rhnplugin
repo id               repo name                                     status
epel                  Extra Packages for Enterprise Linux 6 - x86_64      7,124
```

These instructions also apply to similar Linux distributions such as Red Hat Enterprise Linux, CentOS, and Scientific Linux.

Next, follow the RPM-based installation documentation at Installing RPM packages.

2.4.2 Launching

After MySQL Workbench has been installed, it can be launched by selecting Applications, Programming, MySQL Workbench from the main menu.

MySQL Workbench can also be launched from the command line on Linux. Type the command:

```
shell> /usr/bin/mysql-workbench --help
```

This will display the available command-line options:

```
mysql-workbench [<options>] [<name of a model file or sql script>]

Options:
  --force-sw-render       Force Xlib rendering
  --force-opengl-render   Force OpenGL rendering
  --query [<connection>|<connection string>]
                          Open a query tab and ask for connection if nothing is specified.
                          If named connection is specified it will be opened, else connection
                          will be created based on the given connection string, which should
                          be in form <user>@<host>:<port>
  --admin <instance>      Open a administration tab to the named instance
  --upgrade-mysql-dbs     Open a migration wizard tab
  --model <model file>    Open the given EER model file
  --script <sql file>     Open the given SQL file in an connection, best in conjunction with
                          a query parameter
  --run-script <file>     Execute Python code from a file
  --run <code>            Execute the given Python code
  --run-python <code>     Execute the given Python code
  --migration             Open the Migration Wizard tab
  --quit-when-done        Quit Workbench when the script is done
  --log-to-stderr         Also log to stderr
  --help, -h              Show command line options and exit
  --log-level=<level>     Valid levels are: error, warning, info, debug1, debug2, debug3
  --verbose, -v           Enable diagnostics output
  --version               Show Workbench version number and exit
  --open <file>           Open the given file at startup (deprecated, use script, model etc.)
```

2.4.3 Uninstalling

The procedure for uninstalling MySQL Workbench on Linux depends on the package you are using.

Note

When using apt, the official package name at dev.mysql.com is `mysql-workbench-community`, whereas most Linux distributions use the name `mysql-workbench`. Adjust the following commands accordingly.

Uninstalling DEB packages

To uninstall a Debian package, use the following:

```
shell> sudo apt-get remove mysql-workbench-community
```

Or, alternatively:

```
shell> sudo dpkg -r mysql-workbench-community
```

This command does not remove the configuration files. If you wish to also remove the configuration files, use this command:

```
shell> sudo dpkg --purge mysql-workbench-community
```

Uninstalling RPM packages

Note

When using yum, the official package name at dev.mysql.com is `mysql-workbench-community`, whereas most Linux distributions use the name `mysql-workbench`. Adjust the following commands accordingly.

To uninstall an RPM package, use this command:

```
shell> sudo yum remove mysql-workbench-community
```

Or, alternatively:

```
shell> sudo rpm -e mysql-workbench-community
```

This command does not remove the configuration files.

What Is Not Removed

By default, the uninstallation process does not remove your MySQL Workbench configuration directory. This directory includes your MySQL connections, configuration settings, cache files, SQL snippets and history, logs, custom modules, and more. These files are stored under your user's `.mysql/workbench/` directory.

Note

By default, the MySQL Workbench configuration directory is `~username/mysql/workbench/` where "~username" is the path to your user's home directory.

Also, the uninstallation process does not remove the `.mysqlworkbench` schema that MySQL Workbench creates when sharing SQL snippets across a MySQL connection. For additional information about shared snippets, see Section 8.1.5, “SQL Snippets tab”.

2.5 MySQL Workbench on OS X

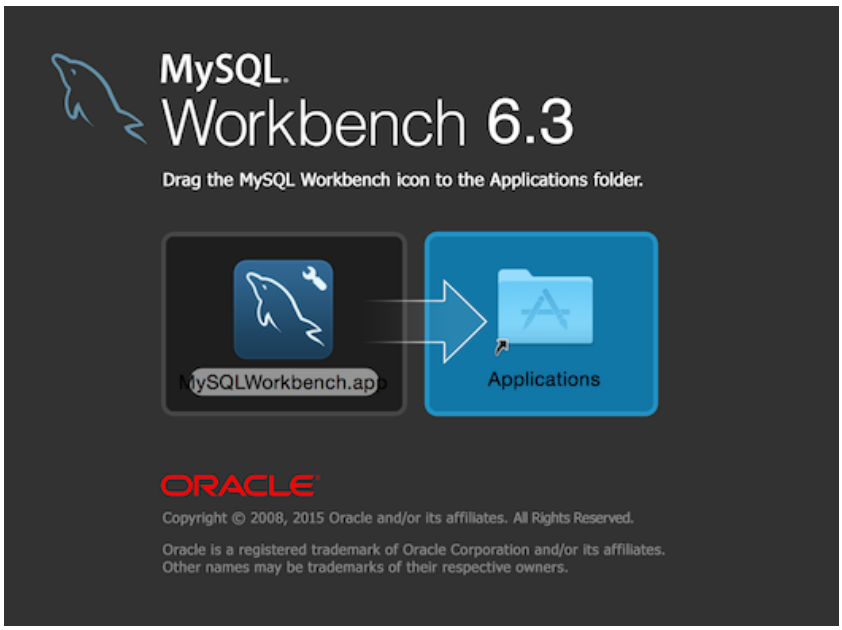
2.5.1 Installing

MySQL Workbench for OS X is distributed as a DMG file. The file is named `mysql-workbench-community-`*`version`*`-osx.dmg`, where *`version`* is the MySQL Workbench version.

Downloads are available at http://dev.mysql.com/downloads/workbench/.

To install MySQL Workbench on OS X, download the file. Double-click the downloaded file. You will be presented with the installation window.

Figure 2.1 MySQL Workbench OS X Installation Window


MySQL
Workbench 6.3
Drag the MySQL Workbench icon to the Applications folder.
MySQLWorkbench.app
Applications
ORACLE
Copyright © 2008, 2015 Oracle and/or its affiliates. All Rights Reserved.
Oracle is a registered trademark of Oracle Corporation and/or its affiliates.
Other names may be trademarks of their respective owners.

Drag the MySQL Workbench icon onto the Applications icon as instructed. MySQL Workbench is now installed.

You can now launch MySQL Workbench from the Applications folder, or from the command line:

```
shell> /Applications/MySQLWorkbench.app/Contents/MacOS/MySQLWorkbench --help
```

This will display the available command-line options:

```
MySQLWorkbench [<options>] [<name of a model file or sql script>]
Options:
  --query [<connection>|<connection string>]
                          Open a query tab and ask for connection if nothing is specified.
                          If named connection is specified it will be opened,
                          else connection will be created based on the given connection string,
                          which should be in form <user>@<host>:<port>
  --admin <instance>      Open a administration tab to the named instance
  --upgrade-mysql-dbs     Open a migration wizard tab
  --model <model file>    Open the given EER model file
  --script <sql file>     Open the given SQL file in an connection, best in conjunction
                          with a query parameter
  --run-script <file>     Execute Python code from a file
  --run <code>            Execute the given Python code
  --run-python <code>     Execute the given Python code
  --migration             Open the Migration Wizard tab
  --quit-when-done        Quit Workbench when the script is done
  --log-to-stderr         Also log to stderr
  --help, -h              Show command line options and exit
  --log-level=<level>     Valid levels are: error, warning, info, debug1, debug2, debug3
  --verbose, -v           Enable diagnostics output
  --version               Show Workbench version number and exit
  --open <file>           Open the given file at startup (deprecated, use script, model etc.)
```

2.5.2 Launching

To launch MySQL Workbench on OS X, open the Applications folder in the Finder, then double-click MySQL Workbench.

It is also possible to start MySQL Workbench from the command line:

```
shell> open MySQLWorkbench.app [options] [model_file]
```

Specifying options and/or a model file is optional.

2.5.3 Uninstalling

To uninstall MySQL Workbench for OS X, locate MySQL Workbench in the Applications folder, right-click, and select Move to Trash.

What Is Not Removed

By default, the uninstallation process does not remove your MySQL Workbench configuration directory. This directory includes your MySQL connections, configuration settings, cache files, SQL snippets and history, logs, custom modules, and more. These files are stored under your user's `MySQL/Workbench/` folder.

Note

By default, the MySQL Workbench configuration directory is `~username/Library/Application Support/MySQL/Workbench` where "~username" is the path to your user's home directory.

Also, the uninstallation process does not remove the `.mysqlworkbench` schema that MySQL Workbench creates when sharing SQL snippets across a MySQL connection. For additional information about shared snippets, see Section 8.1.5, “SQL Snippets tab”.

Chapter 3 Configuration

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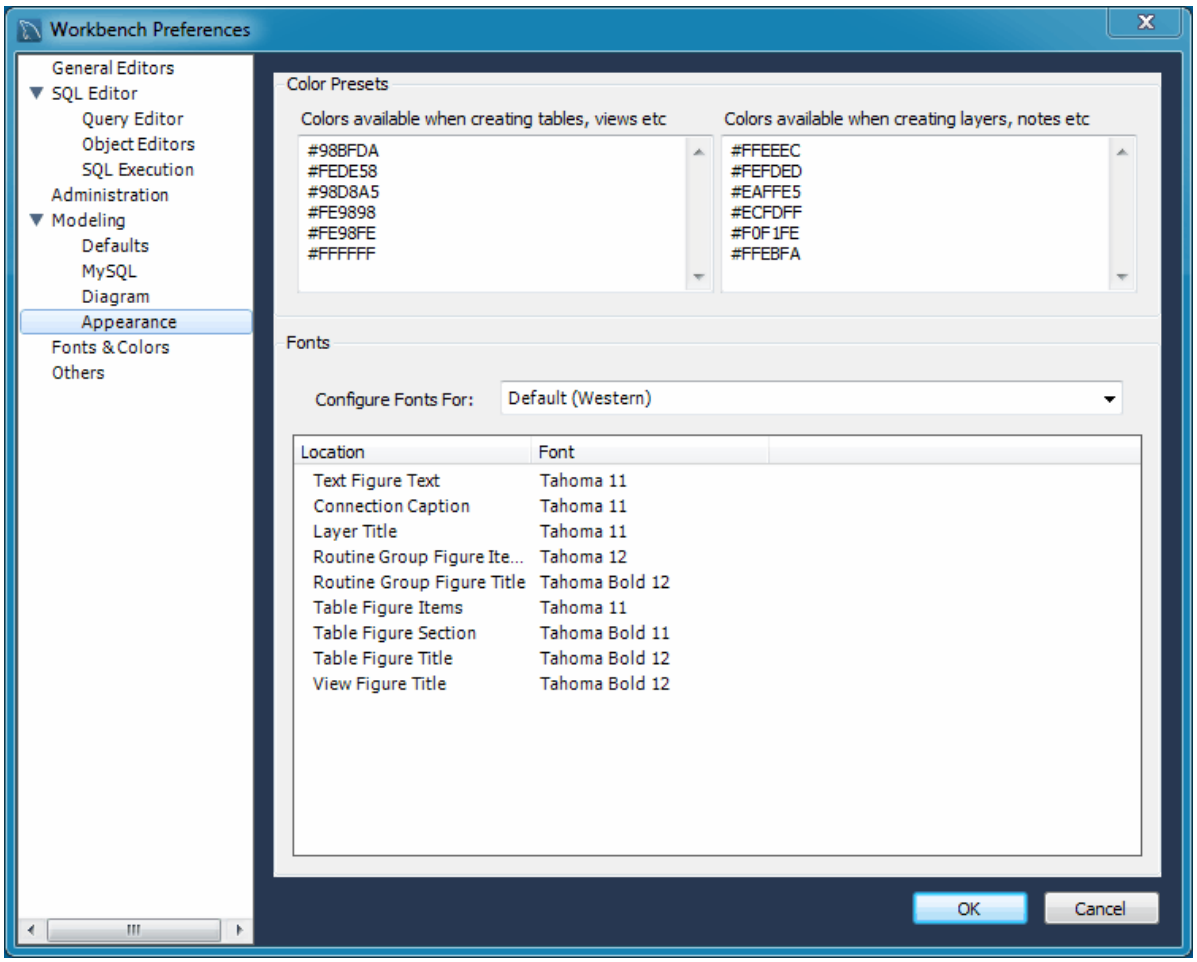
3.1 User Accessibility Options

MySQL Workbench includes methods to improve user accessibility.

Fonts

Under **Preferences**, modeling fonts are adjustable from the **Appearance** section of the **Modeling** menu:

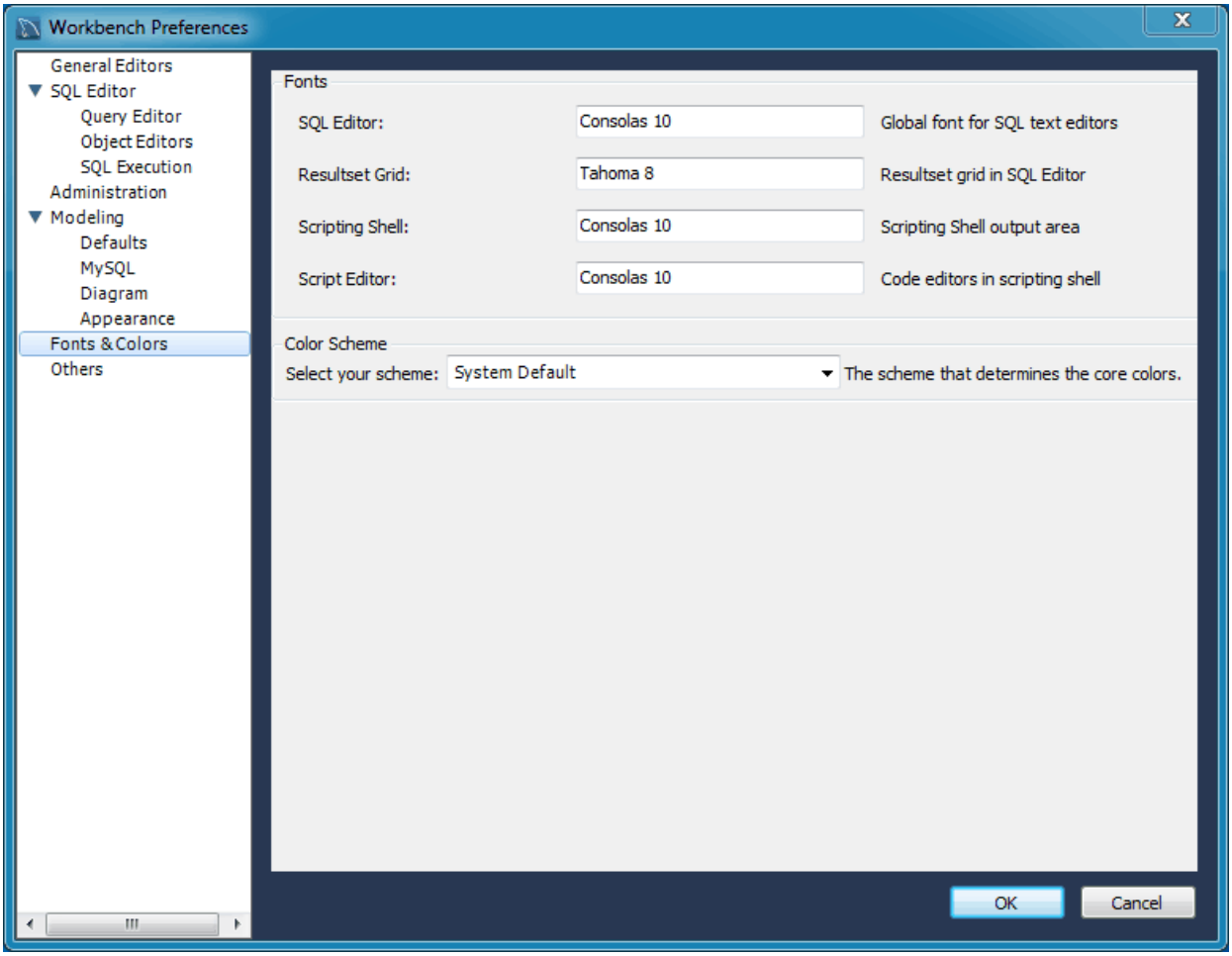
Figure 3.1 Appearance Preferences



Choose the character set under the **Configure Fonts For** setting (typically leave the default setting here) and then adjust the model fonts to fit your needs.

The font types and sizes for other GUI elements are set under the **Fonts & Colors** tab:

Figure 3.2 Fonts & Color Preferences

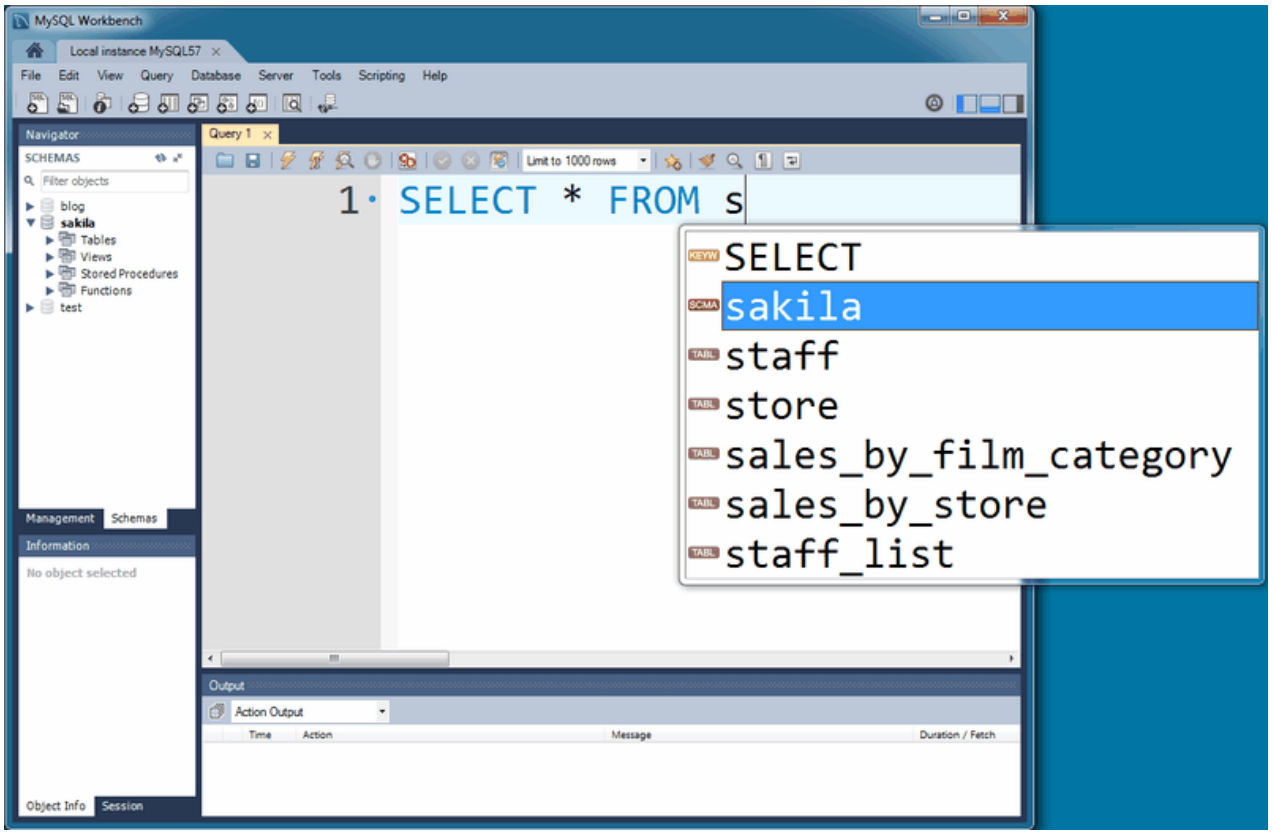


Note

Font changes require a refresh or restart before they take effect.

The following image shows the SQL Editor after changing the **Editor** font size from 10 to 30:

Figure 3.3 SQL Editor with Font size 30



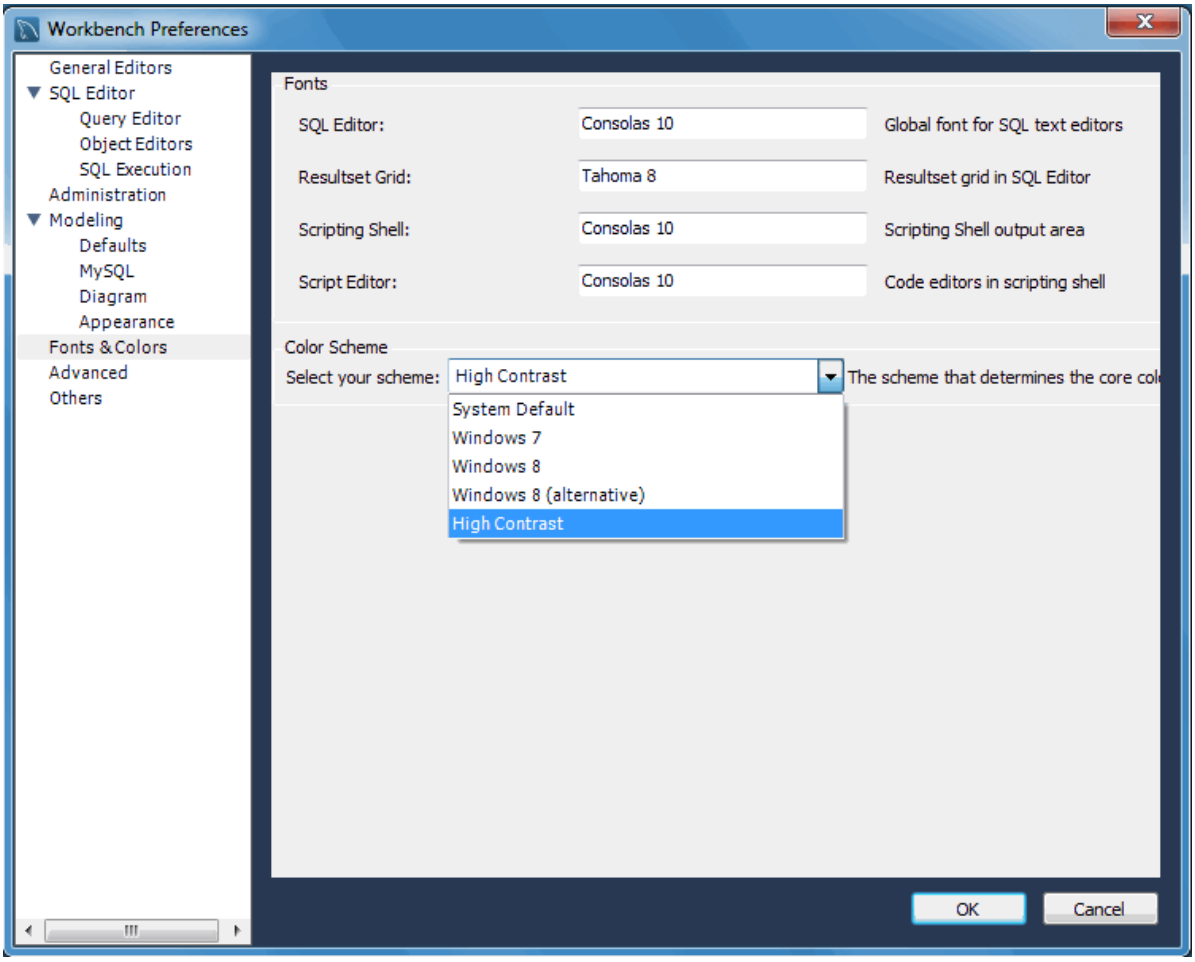
Color Presets

Here you define the colors used in EER diagrams for the tables, views, layers, and notes. You can edit or add additional color choices by entering their ASCII values.

Theming

On Windows, the **Fonts & Colors** preference tab also includes a "Color Scheme" configuration section. From here, you can enable the **High Contrast** color theme. This theme preference affects the MySQL Workbench GUI.

Figure 3.4 High Contrast Preference



Microsoft Active Accessibility (MSAA)

On Windows, MySQL Workbench supports MSAA, which allows use of screen reader applications with MySQL Workbench.

3.2 Workbench Preferences

Use the Preferences menu to configure MySQL Workbench to your specific needs. This menu is divided sections, as described below:

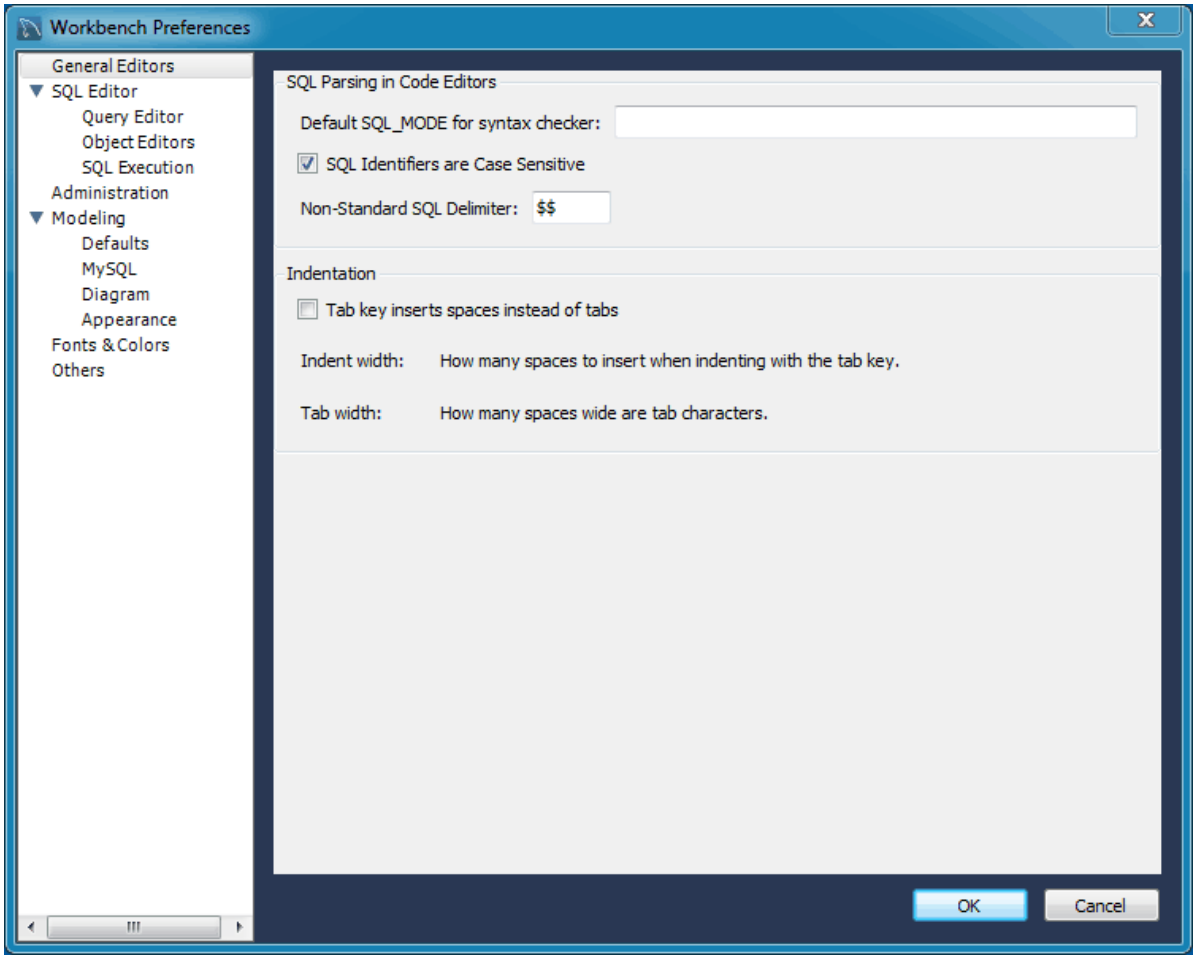
- General Editors: General-purpose editor options, such as SQL parsing options.
- SQL Editor: SQL editor related preferences that also includes subsections for the **Query Editor**, **Object Editor**, and **SQL Execution**.
- Administration: Tools used by the Administrator functionality.
- Modeling: Model related preferences that also includes subsections for **Defaults**, **MySQL** (MySQL specific settings), **Diagram** (EER), and **Appearance** (model colors and fonts).
- Fonts & Colors: Change fonts for tools such as the SQL editor and results grid.
- Others: Miscellaneous options.

A more detailed discussion of these options follows.

3.2.1 General Editors Preferences

The **General Editors** preferences section:

Figure 3.5 Preferences: General Editors



SQL Parsing in Code Editors

SQL properties that can be set include the `SQL_MODE`, case sensitivity of identifiers, and the SQL delimiter used.

- **Default SQL_MODE for syntax checker**: Optionally configure the SQL_MODE for the SQL editor's SQL syntax checker.

  The document property `SqlMode` defines `SQL_MODE` for all operations affecting SQL parsing at the document scope. The purpose of this option is to preserve the consistency of SQL statements within the document.

  The property has the following functions:

  - Sets the `SQL_MODE` DBMS session variable to the value stored in the `SqlMode` property of the document when performing reverse engineering, forward engineering, or synchronization operations.

- Honors the `SQL_MODE` values defined in `SqlMode` so that SQL parsing is correct.

Only a subset of all possible `SQL_MODE` values affect the MySQL Workbench SQL parser. These values are: `ANSI_QUOTES`, `HIGH_NOT_PRECEDENCE`, `IGNORE_SPACE`, `NO_BACKSLASH_ESCAPES`, `PIPES_AS_CONCAT`. Other values do not affect the MySQL Workbench SQL parser and are ignored.

If the value of `SqlMode` is not set, the default value of the `SQL_MODE` session variable defined by the server stays unchanged during operations with the server. However, the MySQL Workbench SQL parser behaves as if `SQL_MODE` is also not set. This may potentially lead to inconsistencies in parsing of SQL statements stored in the document. If you choose to not set the `SqlMode` property, ensure that the default `SQL_MODE` variable defined by the server does not contain any values from the following list: `ANSI_QUOTES`, `HIGH_NOT_PRECEDENCE`, `IGNORE_SPACE`, `NO_BACKSLASH_ESCAPES`, `PIPES_AS_CONCAT`.

The `SqlMode` property is defined in two locations: globally and at document scope. MySQL Workbench uses the global property to initialize the document property for each new document created. For each document, the property value defined at document scope always has higher priority over the one defined globally.

- [ ] **SQL Identifiers are Case Sensitive**: Whether to treat identifiers separately if their names differ only in letter case. This is enabled by default.
- **Non-Standard SQL Delimiter**: [*$$*]. Define the SQL statement delimiter to be different from the normally used delimiter (such as ";"). Change this if the deliminator you normally use, specifically in stored routines, happens to be the current setting.

Indentation

Note

This preference section was added in MySQL Workbench 6.2.4.

- [ ] Tab key inserts spaces instead of tabs
- Indent width: [*4*] The number of spaces inserted after pressing Tab -- this assumes that the *Tab key inserts spaces instead of tabs* option is enabled
- Tab width: [*4*] The width (number of spaces) that tab characters are displayed as in MySQL Workbench

3.2.2 SQL Editor Preferences

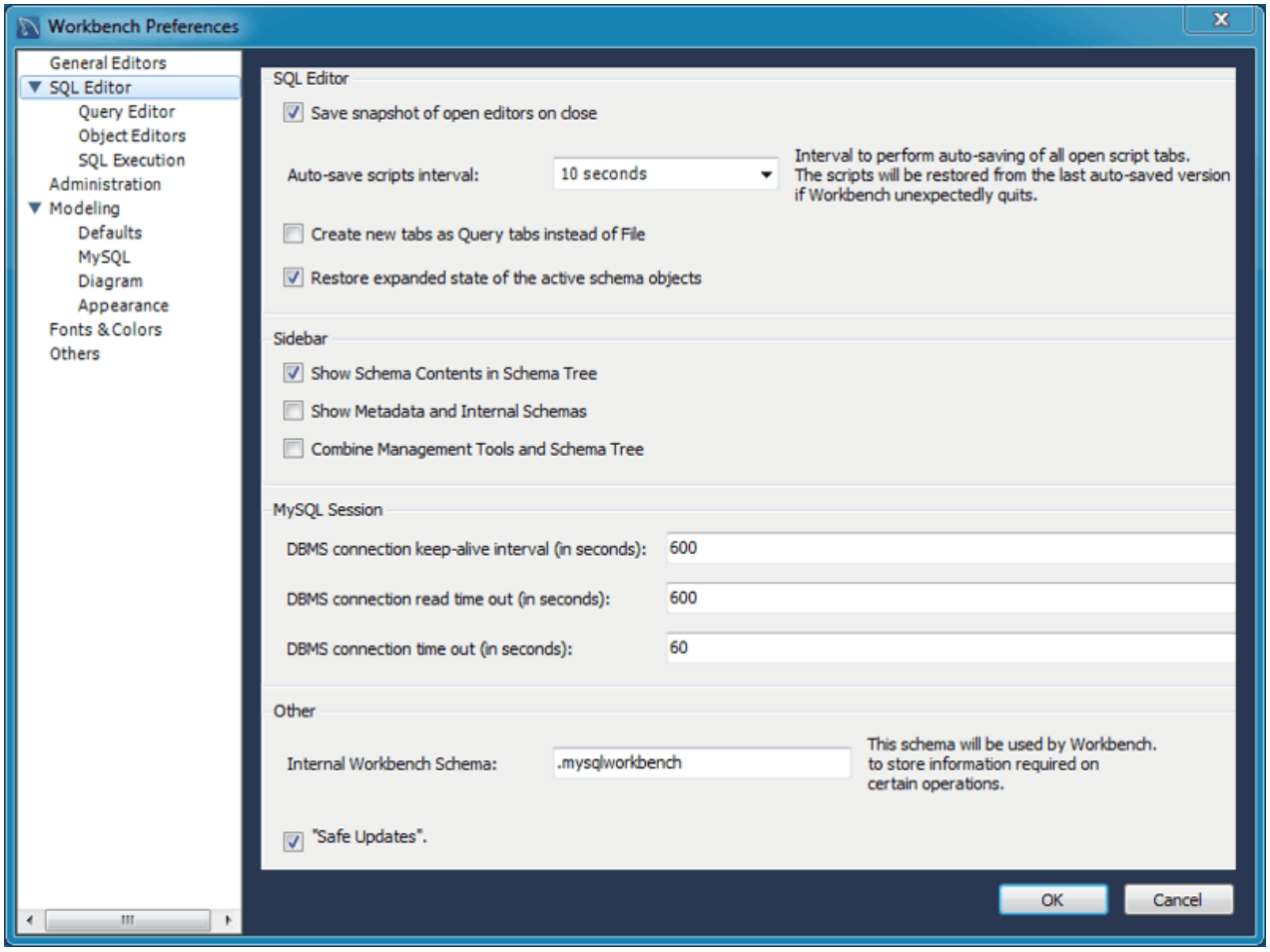
This section provides configuration options that affect the SQL Editor functionality in MySQL Workbench.

The SQL Editor preferences includes three additional sections: Query Editor, Object Editors, and SQL Execution.

Preferences: SQL Editor: Main

SQL Editor

Figure 3.6 Preferences: Main SQL Editor Section



- **Save snapshot of open editors on close**: Enabling will save and reload the SQL Editor tabs after closing/opening MySQL Workbench (including after an unexpected crash).
- **Auto-save scripts interval**: Frequency of the auto-saves.
- **Create new tabs as Query tabs instead of File**: By default, opening a new SQL Editor tab opens as an SQL File tab. Check this option if you prefer the simpler Query tabs that, for example, will not prompt to be saved when closed.
- **Restore expanded state of the active schema objects**: Group nodes that were previously expanded in the active schema when the SQL editor was last closed are re-expanded and loaded. This is enabled by default.

Sidebar

- **Show Schema Contents in Schema Tree**: Enumerating, populating, and drawing large numbers of items can significantly increase loading times. For this reason, this facility can be switched off for models containing large numbers of schemata and tables.
- **Show Data Dictionaries and Internal Schemas**: Whether to show data directories and internal schemas in the schema tree (such as `INFORMATION_SCHEMA`, mysql, and schemas starting with ".").

- **Combine Management Tools and Schema Tree tab**: This affects the Object Browser in the left sidebar, and this option can also be toggled from the sidebar. The management tools and schema tree can be viewable as separate tabs, or as a single long list.

MySQL Session

- **DBMS connection keep-alive interval (in seconds)**: [*600*]. Time interval between sending keep-alive messages to the DBMS. Set to 0 to not send keep-alive messages.
- **DBMS connection read time out (in seconds)**: [*600*]. The maximum amount of time the query can take to return data from the DBMS. Set 0 to not check the read time out.
- **DBMS connection time out (in seconds)**: [*60*]. Maximum time to wait before a connection attempt is aborted.

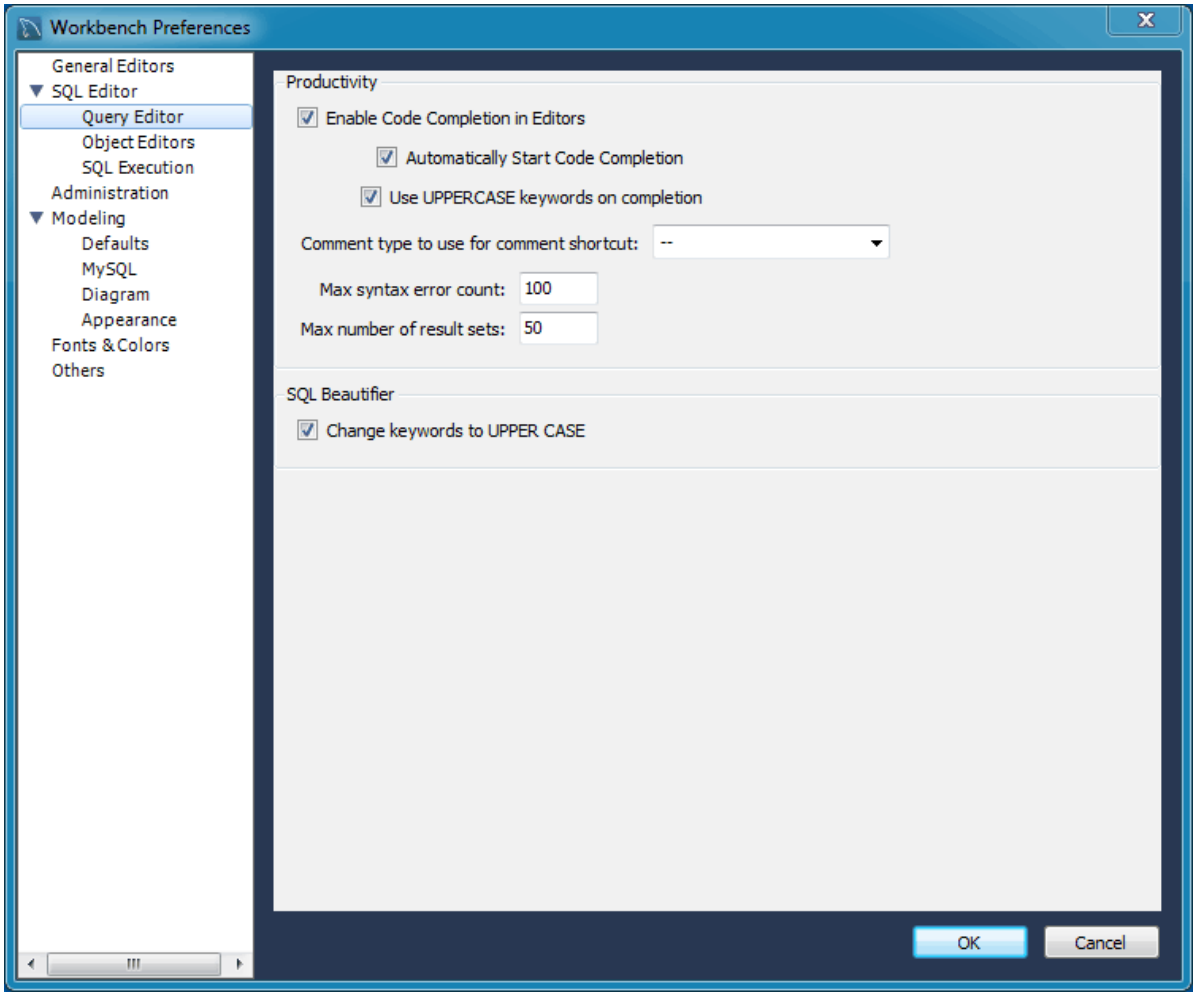
Other

- **Internal Workbench Schema**: [*.mysqlworkbench*]. This schema is used by MySQL Workbench to store information required for certain operations, such as saving shared SQL snippets.
- [ ] : **"Safe Updates"**, forbid UPDATE and DELETE queries to execute that lack a corresponding key in a WHERE clause, or lack a LIMIT clause. Setting this option requires a MySQL server reconnection.

  This makes it possible to catch UPDATE and DELETE statements where keys are not used properly and that would probably accidentally change or delete a large number of rows.

Preferences: SQL Editor: Query Editor

Figure 3.7 Preferences: SQL Editor: Query Editor



Productivity

- **Enable Code Completion in Editors**: The SQL Editor offers Auto-complete functionality by either pressing the keyboard shortcut (**Modifier** + **Space**), or it will start automatically if the **Automatically Start Code Completion** preference is enabled.
- **Automatically Start Code Completion**: Enabled by default, this will automatically execute the code auto-completion feature while editing SQL in the SQL Editor. If disabled, you will instead use the keyboard shortcut **Modifier** + **Space** to execute the auto-completion routine.
- **Use UPPERCASE keywords on completion**: Normally keywords are shown and inserted as they come from the code editor's configuration file. This setting will always write completed keywords as uppercase.
- **Comment type to use for comment shortcut**: [- -]. Defaults to "--", with "#" as another option.
- **Max syntax error count**: Large complex scripts may contain errors. Further, a syntax error early on can lead to subsequent syntax errors. For these reasons, it is possible to limit the number of errors displayed using this option. The default is 100 error messages.
- **Max number of result sets**: Maximum number of result sets for SQL queries that can be opened for a single SQL editor. Defaults to 50. Reaching the limit emits a warning.

Note

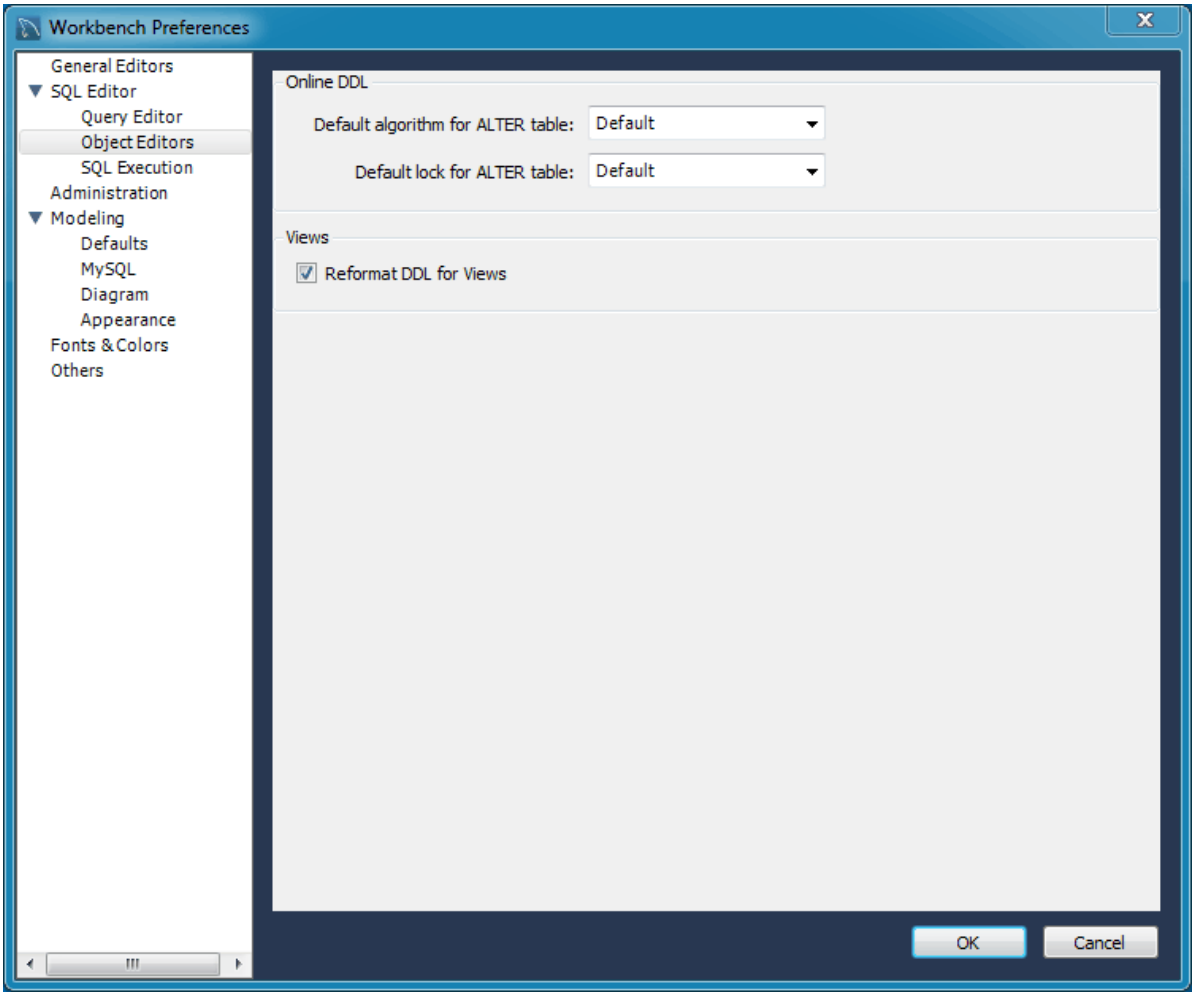
This option was added in MySQL Workbench 6.2.4.

SQL Beautifier

- [ ] **Change keywords to UPPER CASE**: Enabled by default, executing the SQL beautifier will uppercase all SQL keywords.

Preferences: SQL Editor: Object Editors

Figure 3.8 Preferences: SQL Editor: Object Editors



Online DDL

- **Default algorithm for ALTER table**: The default algorithm selected when performing `ALTER TABLE` operations in MySQL Workbench. The setting can also be adjusted for each `ALTER TABLE` operation. Options include "In-Place" (preferred) and "Copy", see the online DDL documentation for more information.
- **Default lock for ALTER table**: The default lock setting for allowing concurrent queries with `ALTER TABLE` in MySQL Workbench. This setting can also be adjusted for each `ALTER TABLE` operation.

Options include "None", "Shared", and "Exclusive", see the online DDL documentation for more information.

Views

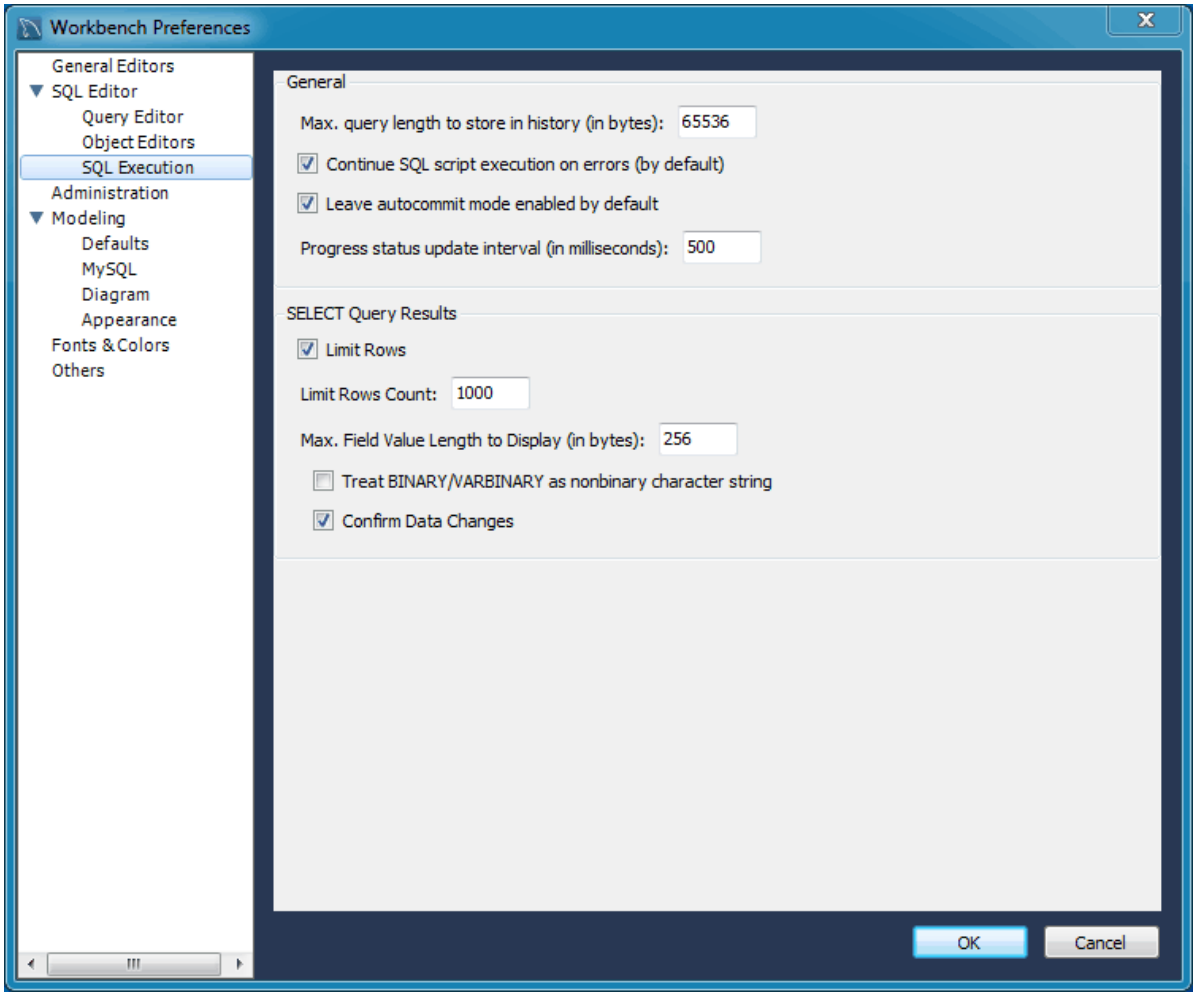
- **Reformat DDL for Views**: Whether to automatically reformat the View DDL that is returned by the MySQL Server.

Note

The MySQL Server does not store the formatting information for View definitions.

Preferences: SQL Editor: SQL Execution

Figure 3.9 Preferences: SQL Editor: SQL Execution



General

- **Max query length to store in history (in bytes)**: Queries that exceed this size will not be saved in the history when executed. The default is 65536 bytes, and setting to 0 means there is no limit (all queries will be saved).
- **Continue on SQL Script Error**: Should an error occur while executing a script, this option causes execution to continue for the remainder of the script.

- **Leave autocommit mode enabled by default**: Toggles the default autocommit mode for connections. When enabled, each statement will be committed immediately.

Note

All query tabs in the same connection share the same transaction. To have independent transactions, you must open a new connection.

- **Progress status update interval**: When executing long running queries over a slow connection, you may need to increase this value to prevent excess load on the connection. Defaults to 500 milliseconds.

SELECT Query Results

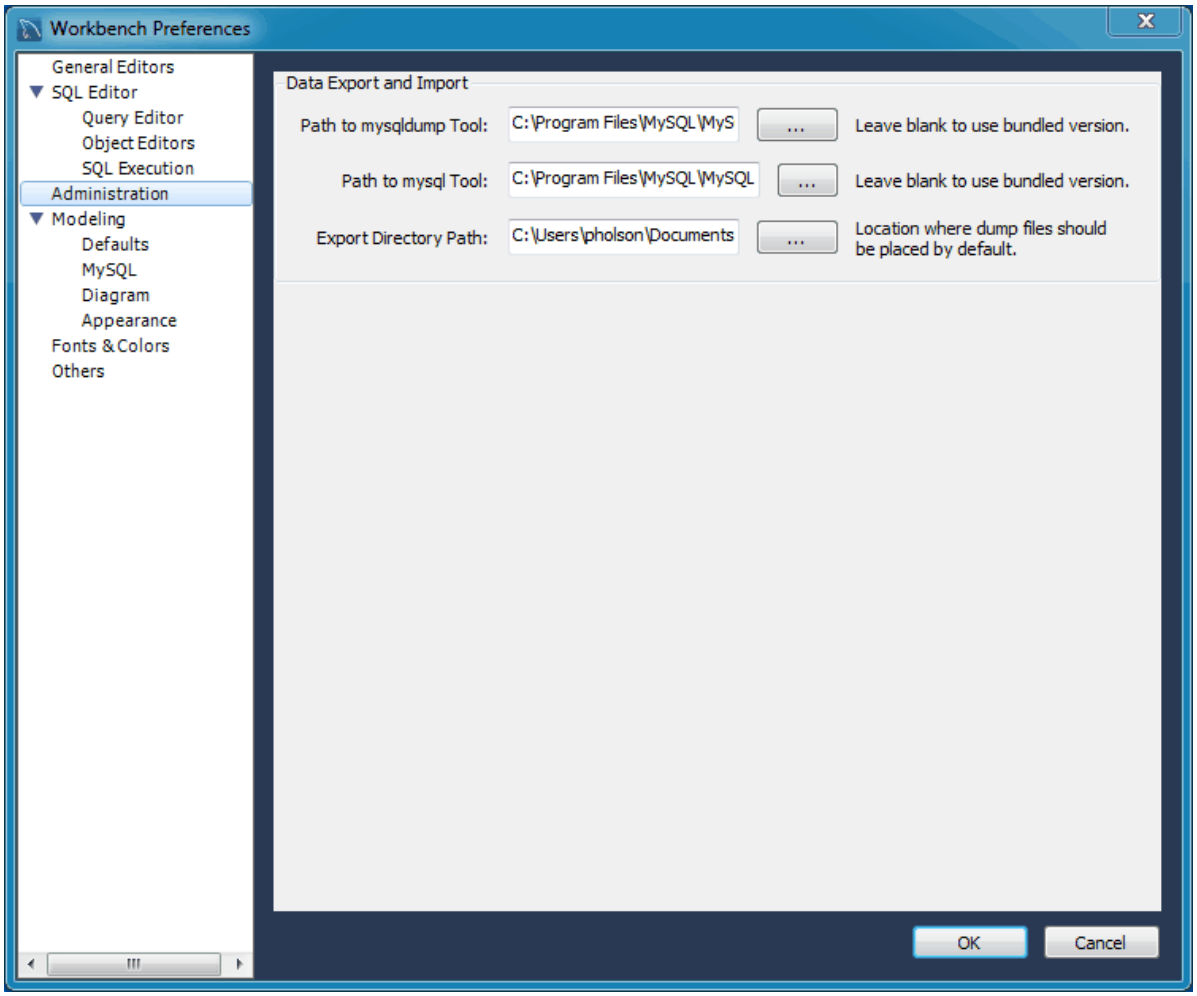
- **Limit Rows**: Queries can sometimes return an excessive number of rows, which can heavily load the connection, and take time to display in MySQL Workbench. To prevent this, you can set a more moderate value here. This limit is defined by the **Limit Rows Count** option.
- **Limit Rows Count**: Specify the maximum number of result rows to return. Defaults to 1000.
- **Max. Field Value Length to Display**: To avoid display problems due to excessive field length, it is possible to set the maximum field length to display (in bytes). Defaults to 256.
- **Treat BINARY/VARBINARY as non-binary character string**: Binary byte string values are not displayed by default in the results grid, but are instead marked as `BLOB` values. These can then be viewed or edited with the `BLOB` editor. Nonbinary character string values are displayed in the results grid, and can be edited in the grid cell or using the `BLOB` editor.

  If this option is turned on, data truncation may result: Binary byte string values may contain null bytes as part of their valid data, whereas for nonbinary character strings, a null byte terminates the string.
- **Confirm Data Changes**: In the SQL Editor, if you edit table data and then click the Applying changes to data button, MySQL Workbench launches a wizard to step you through applying your changes. This gives you a chance to review the SQL that will be applied to the live server to make the requested changes. If this option is deselected, the changes will be applied to the server without the wizard being displayed and without giving you a chance to review the changes that will be made.

3.2.3 Administration Preferences

This section provides configuration options that affect the Administration functionality in MySQL Workbench.

Figure 3.10 Preferences: Administration



Data Export and Import

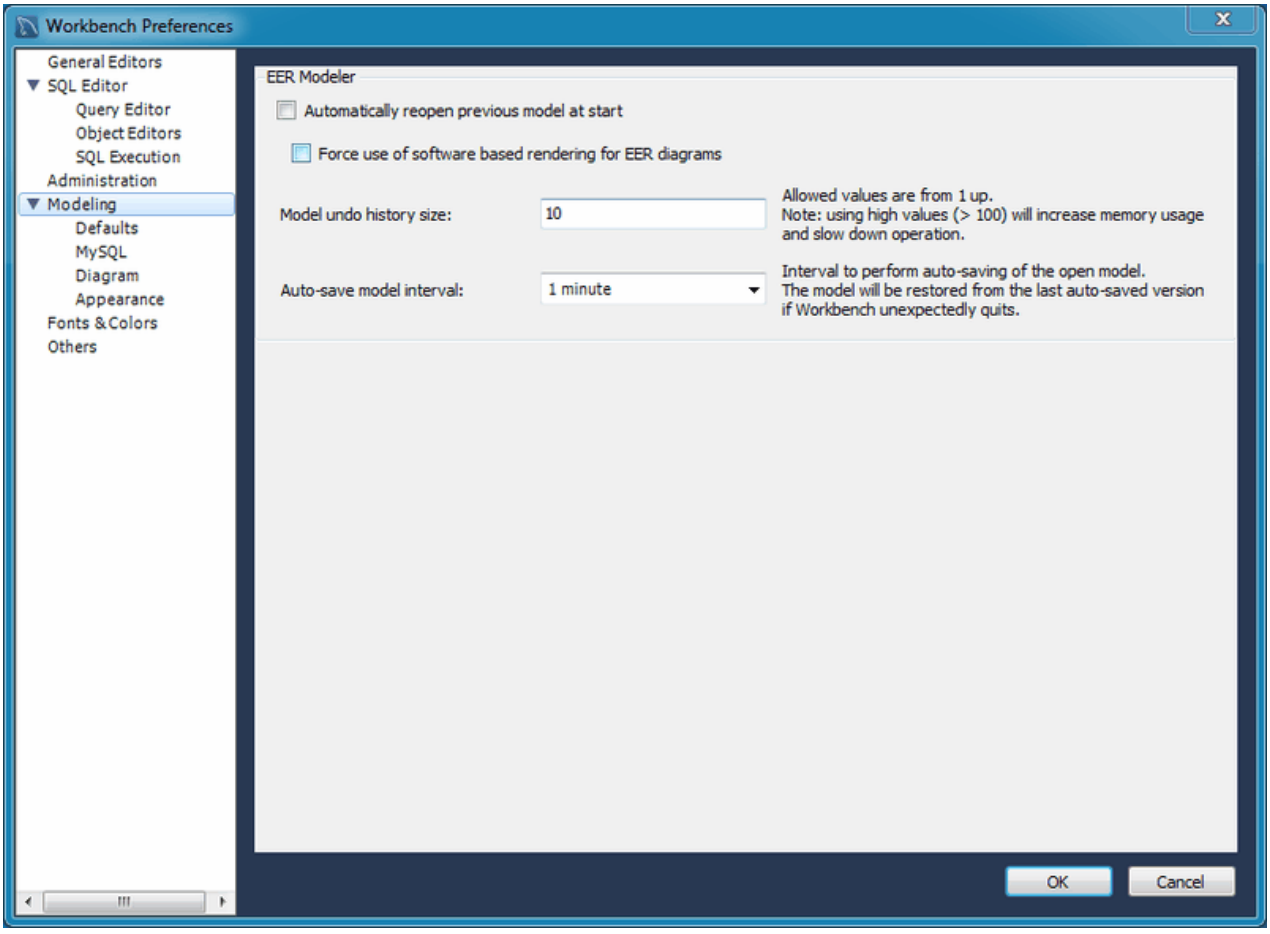
- **Path to mysqldump tool**: Path to your local mysqldump binary. Leave it blank to use the bundled mysqldump binary.
- **Path to mysql tool**: Path to your local mysql client binary. Leave it blank to use the bundled mysql binary.
- **Export Directory Path**: Directory where your exported mysql dumps are located.

3.2.4 Modeling Preferences

This section provides configuration options that affect the Modeling functionality in MySQL Workbench.

Preferences: Modeling: Main

Figure 3.11 Preferences: Modeling



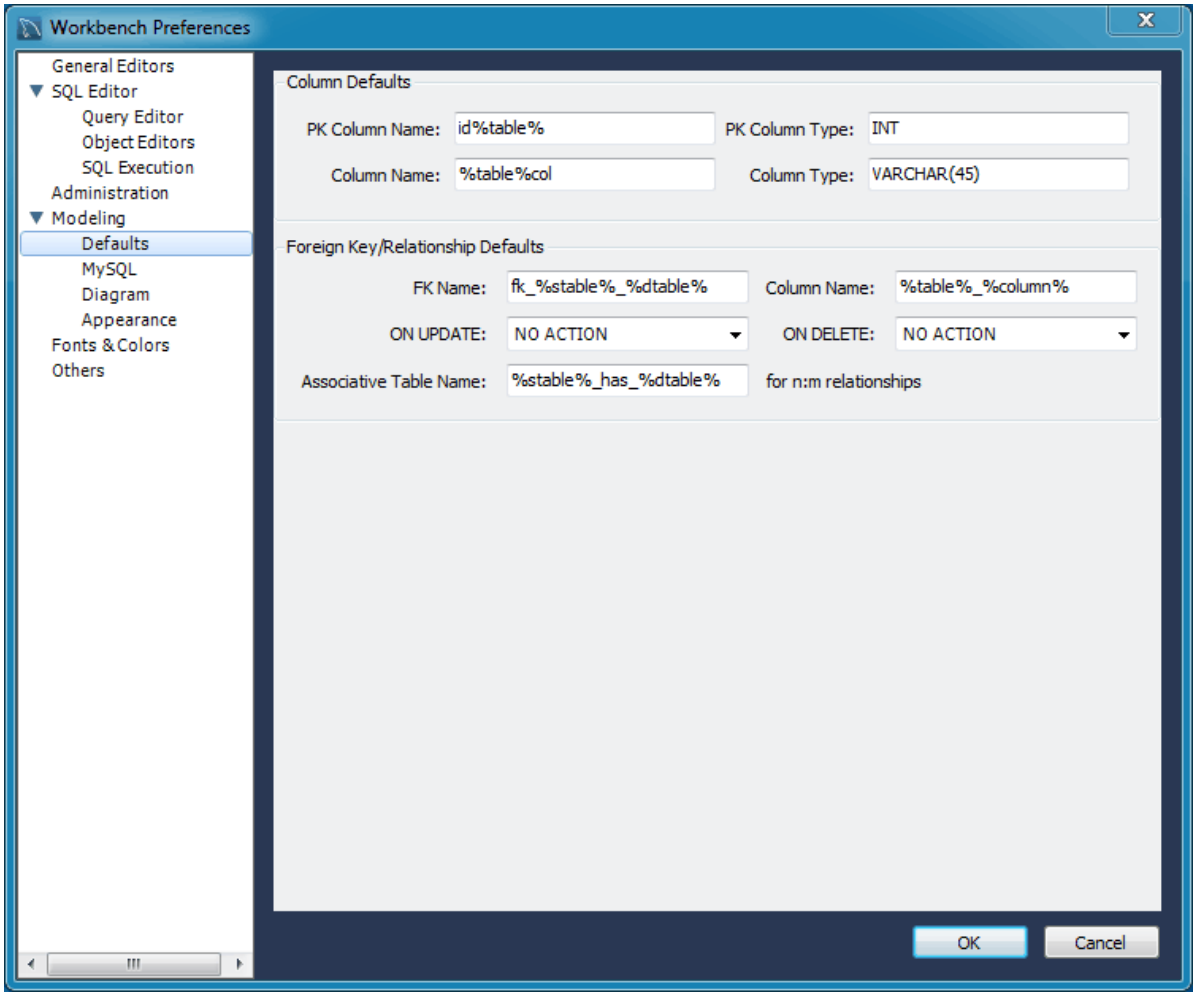
EER Modeler

- **Automatically reopen previous model at start**: Check this if you want the model on which you previously worked to be automatically reopened when you start MySQL Workbench.
- **Force use of software based rendering for EER diagrams**: MySQL Workbench will use OpenGL for rendering when available. However, due to faulty drivers, problems do occasionally occur. These issues can be resolved by selecting the software rendering option here.
- **Model undo history size**: You can limit the size of the undo history here. Set this value to 0 to have an unlimited undo history.
- **Auto-save model interval**: An open model that has not been saved will automatically be saved after this period. On loading a model file, MySQL Workbench will notify the user if the file was not previously saved correctly, due to a crash or power failure. MySQL Workbench can then attempt to recover the last auto-saved version. For automatic recovery to be available for a new file, it will have to have been saved at least once by the user.

Preferences: Modeling: Defaults

Sets default values for modeling object names.

Figure 3.12 Preferences: Modeling: Defaults



The following tables show the object names and their default values.

Column Defaults

Object Name	Default Value
PK Column Name	id%table%
PK Column Type	INT
Column Name	%table%col
Column Type	VARCHAR(45)

Foreign Key/Relationship Defaults

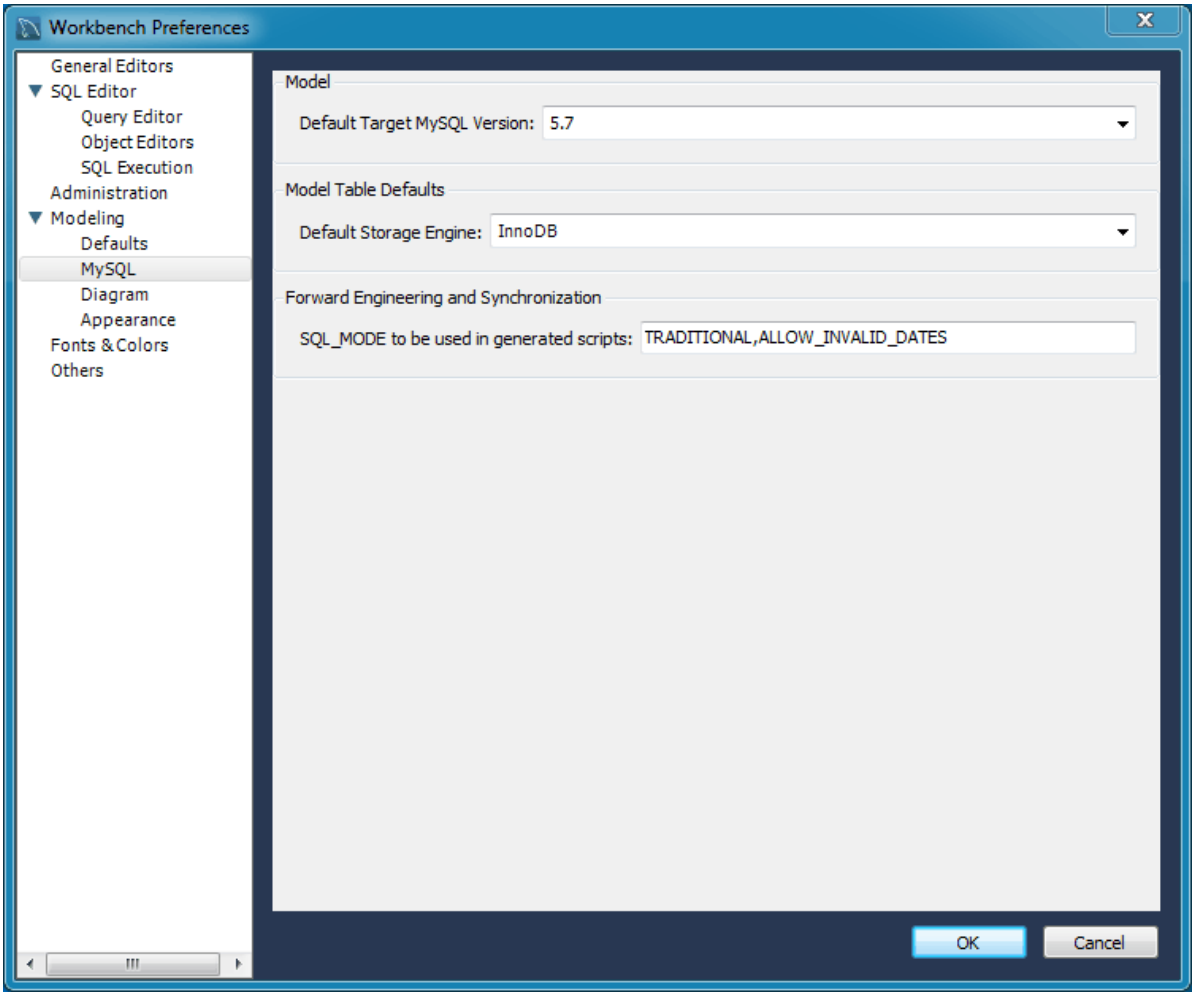
Object Name	Default Value
FK Name	fk%stable_%dtable%
Column Name	%table%_%column%
ON UPDATE	NO ACTION
ON DELETE	NO ACTION

Object Name	Default Value
`Associative Table Name`	`%stable%_has_%dtable%`

Preferences: Modeling: MySQL

This enables you to set model related options specific to your MySQL version.

Figure 3.13 Preferences: Modeling: MySQL



Model

- **Default Target MySQL Version**: A limited subset of validation procedures and table editor options are affected by this MySQL version number.

  Supported MySQL Server 5.6 features include fraction seconds support for `TIME`, `DATETIME`, and `TIMESTAMP`, automatic initialization and updates for `TIMESTAMP` and `DATETIME` (for example, setting them to `CURRENT_TIMESTAMP`), and FULLTEXT index types with the InnoDB engine.

Model Table Defaults

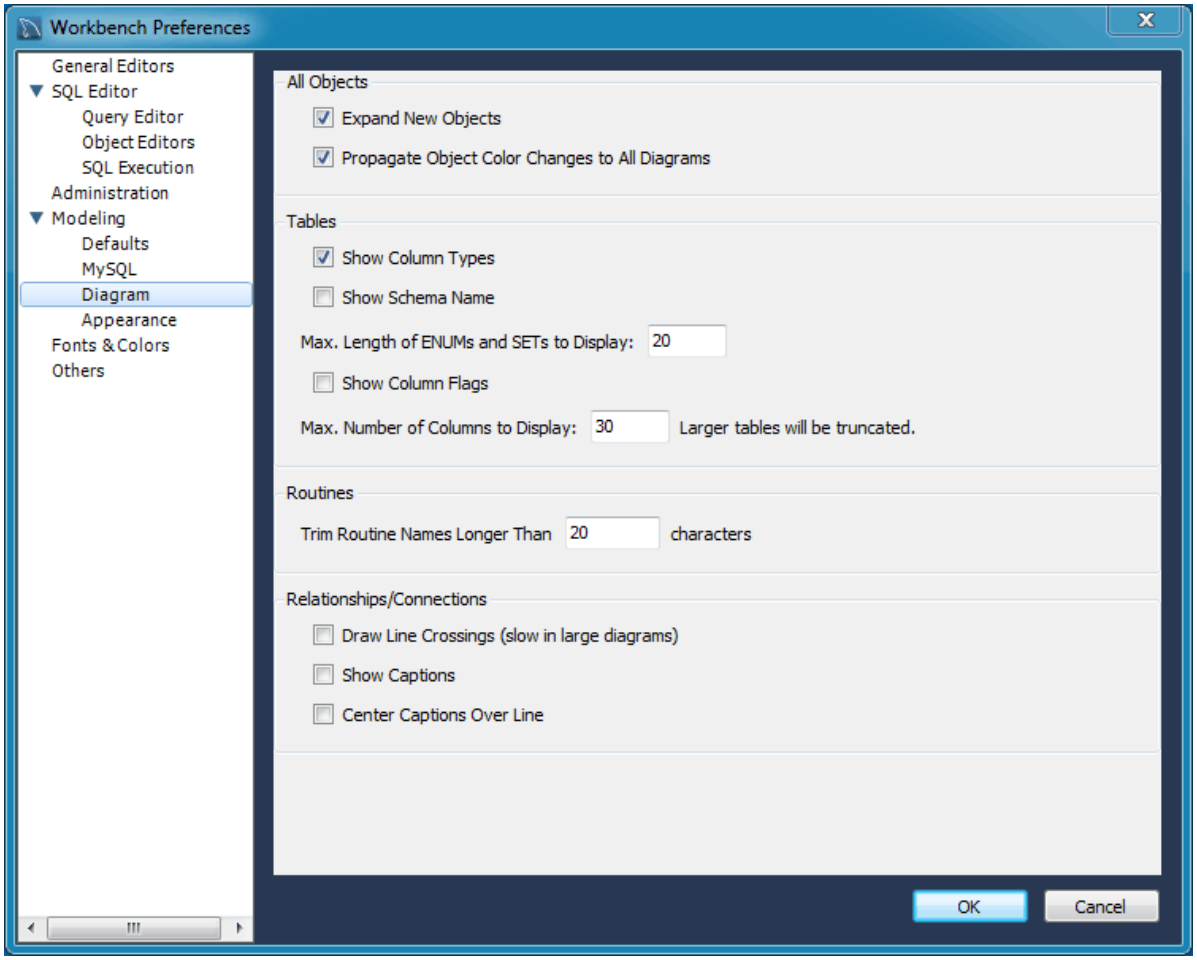
- **Default Storage Engine**: Tables created in MySQL Workbench will be defined using this default storage engine.

Forward Engineering and Synchronization

- **SQL_MODE to be used in generated scripts**: Defaults to "TRADITIONAL,ALLOW_INVALID_DATES", this defines the `SQL_MODE` used by Forward Engineering and Synchronization.

Preferences: Modeling: Diagram

Figure 3.14 Preferences: Modeling: Diagram



All Objects

- [ ] **Expand New Objects**: Enabled by default.
- [ ] **Propagate Object Color Changes to All Diagrams**: Enabled by default.

Tables

- [ ] **Show Column Types**: Enabled by default.
- [ ] **Show Schema Name**:
- **Max. Length of ENUMs and SETs to Display**: [*20*]
- [ ] **Show Column Flags**:

- **Max. Number of Columns to Display**: [*30*] Larger tables will be truncated.

Routines

- **Trim Routine Names Longer Than**: [*20*] characters.

Relationships / Connections

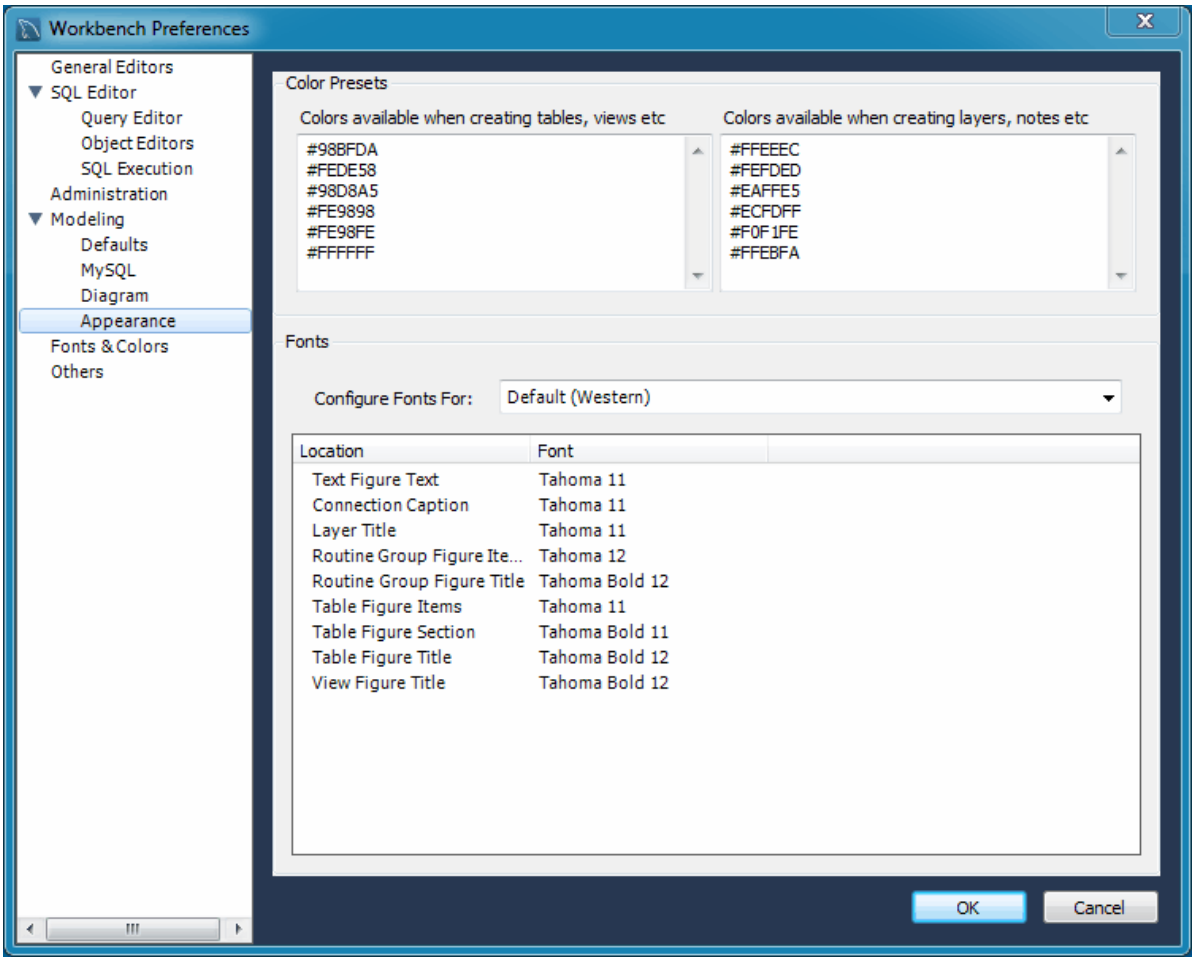
- [ ] **Draw Line Crossings (slow in large diagrams)**:
- [ ] **Hide Captions**: Enabled by default.
- [ ] **Center Captions Over Line**:

Preferences: Modeling: Appearance

Use this tab to set the available colors for the objects that appear on an EER diagram canvas. You can also add colors if you wish.

For related information, see Section 3.1, “User Accessibility Options”.

Figure 3.15 Preferences: Modeling: Appearance



Color Presets

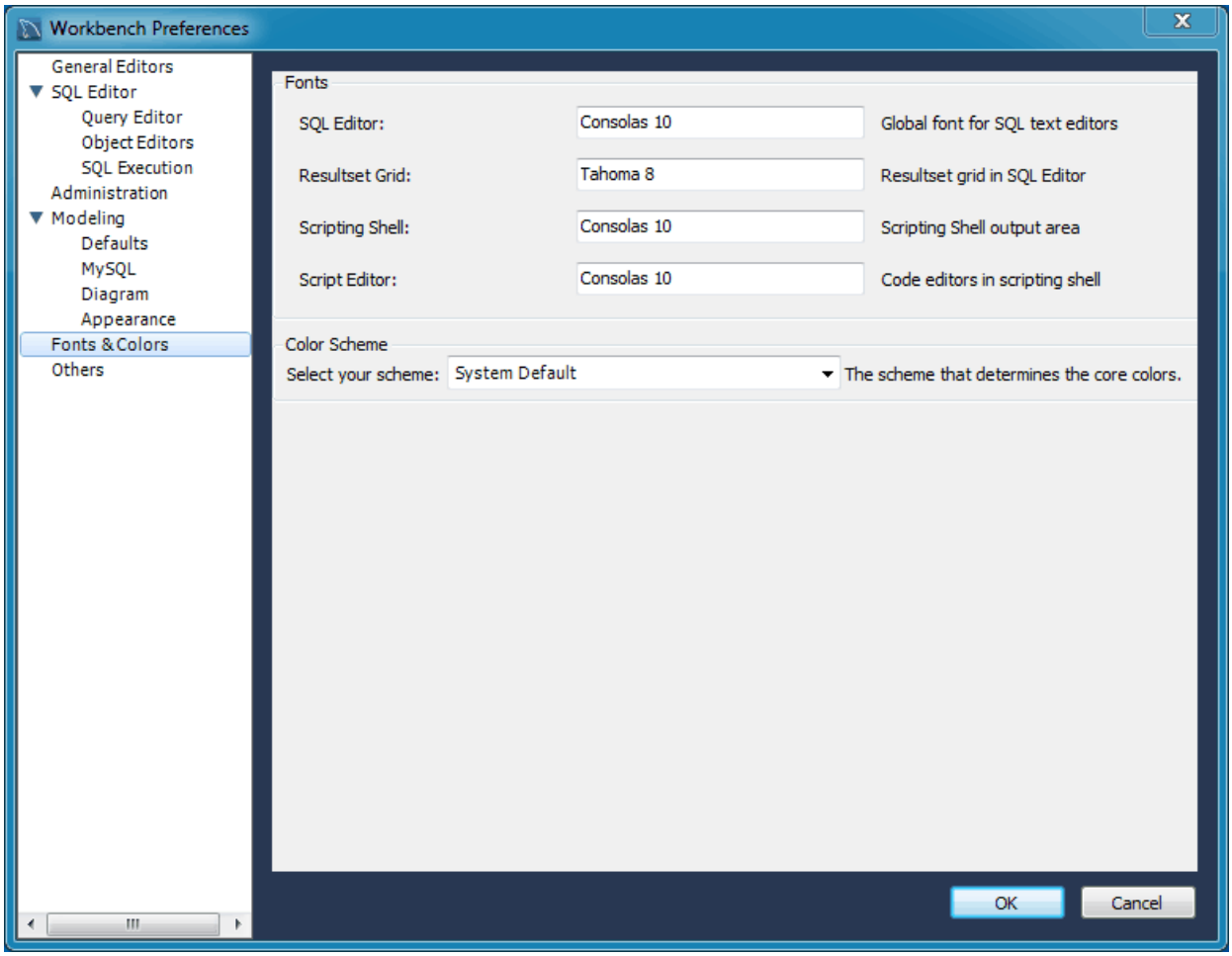
These are the available colors used while modeling, and they are divided into two sections. First, the colors used when creating tables and views. The second section are available colors for items such as layers and notes.

Fonts

These define the fonts and font sizes used while modeling.

3.2.5 Fonts and Colors Preferences

Figure 3.16 Preferences: Fonts and Colors



Fonts

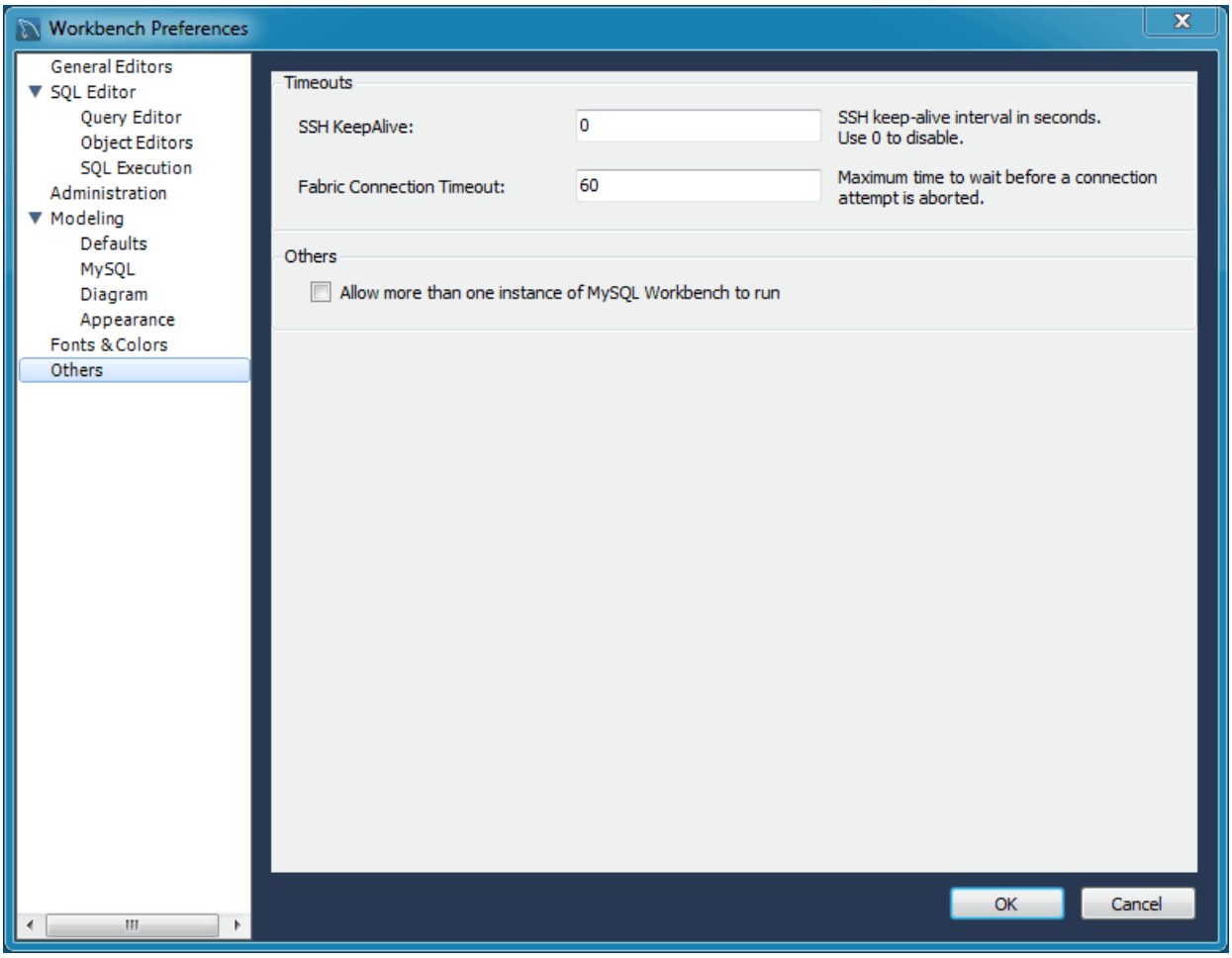
- **SQL Editor**: [*Consolas 10*] -- Global font for SQL text editors.
- **Resultset Grid**: [*Tahoma 8*] -- Resultset grid in SQL editor
- **Scripting Shell**: [*Consolas 10*] -- Scripting Shell output area
- **Script Editor**: [*Consolas 10*] -- Code editors in scripting shell

Color Scheme

On Microsoft Windows, set the scheme that determines the code colors.

3.2.6 Other Preferences

Figure 3.17 Preferences: Others



Timeouts

- **SSH KeepAlive**: [*0*] -- This interval (in seconds) without sending any data over the connection, a "keepalive" packet will be sent. This option applies to both SSH tunnel connections and remote management via SSH.
- **SSH Timeout**: [*10*] -- This interval (in seconds) that online backup/restore will timeout when waiting for a result.

Note

This option was added in Workbench 6.3.5.

- **Fabric Connection Timeout**: [*60*] -- Maximum time to wait before a connection is aborted.

Others

- [ ] Allow more than one instance of MySQL Workbench to run. By default, only one instance of MySQL Workbench can be running at the same time. .

Note

All MySQL Workbench instances share the same files and settings, so enable at your own risk.

3.3 MySQL Workbench Settings and Log Files

MySQL Workbench saves configuration, cache, and log related files and directories on your system. These files are saved in your user's MySQL Workbench directory as defined by MySQL Workbench, with this base defaulting to:

Table 3.1 Default Local Configuration Base File Path

Operating System	File Path
Windows	%AppData%\MySQL\Workbench\
OS X	~username/Library/Application Support/MySQL/Workbench/
Linux	~username/.mysql/workbench/

A brief description of these directories and files:

Table 3.2 Local Workbench Files and Directory Descriptions

Directory or File	Description
cache/	General behaviors are stored per-connection in *.cache files, and column widths as *.column_widths files
log/	Log files include Workbench startup information, and also per-connection SQL action results performed in Workbench
modules/	Home of installed plugins, for additional information see Section C.3, “Plugins / Tools”
sql_history/	Queries executed in Workbench are stored here, and are available from within MySQL Workbench
snippets/	Saved SQL snippets are stored here, for additional information see Section 8.1.5, “SQL Snippets tab”
audit_cache/	Cache storage by the Audit Log inspector, for additional information see Section 6.6, “MySQL Audit Inspector Interface”
`connections.xml`	Saved MySQL server connection information, as seen on the home screen. For information about backing up and restoring this file, see The Tools Menu
`server_instances.xml`	Stores your MySQL server information, as it relates to your MySQL connections
`wb_options.xml`	Stores your preferences, both configured and default

The cache/ directory

The `cache/` directory contains cache files in the user's MySQL Workbench directory. All cache files are stored as SQLite 3 databases, and they are not meant to be edited outside of MySQL Workbench. The types of cache files are:

- ***.column_widths**:

These are the saved column widths after adjusting columns in the SQL editor's results grid. The fields include column_id, stored as column_name::db_name::table_name, and width, stored as an integer of character length.

- ***.cache**:

  This information (schemas, engines, and other global information) serves as a quick lookup source for the SQL editor's auto completion functionality, and is implicitly updated whenever the schema tree is updated.

All cache/ file names begin with the MySQL connection name. For example, the column width file is named `Local_instance_3306.column_widths` for a MySQL connection named "Local Instance 3306".

Cached files remain after a connection is either renamed or deleted.

The log/ directory

MySQL Workbench start up and SQL actions are logged and stored in the `log/` directory. This directory is in the user's MySQL Workbench directory.

Note

To find these text files, from the main Workbench navigation menu choose Help and then Show Log Files.

- **wb*.log**:

  Debugging information is generated when MySQL Workbench is started and unexpectedly stopped. Information includes paths used, modules and plugins loaded, system information, and more. The log files are useful when reporting a MySQL Workbench bug.

  The log files rotates when MySQL Workbench is started, in that `wb.log` is renamed to `wb.1.log`, `wb.log` is reset, and the previous `wb.1.log` file is renamed to `wb.2.log`, and so on, all the way up to `wb.9.log`.

- **sql_actions_*.log**:

  A log of all SQL execution results but without the data, for debugging purposes.

  The SQL editor's SQL history does not originate from here, as it is stored in the `sql_history` directory.

The modules/ directory

Custom plugins (modules) are stored in the `modules` directory. For additional information about MySQL Workbench plugins, see Section C.3, “Plugins / Tools”.

The sql_history/ directory

SQL statements executed in the SQL editor are saved in the `sql_history` directory. They are stored as plain text files that are separated one per day (such as `2015-12-15`) and they contain your MySQL Workbench SQL statement history for all MySQL connections. For additional information, see Section 8.1.7, “Output History Panel”.

The snippets/ directory

SQL snippets used by the SQL editor are stored in the `snippets` directory. These files include bundled snippets (such as "SQL DDL Statements") and custom snippets saved under the "My Snippets" tab. For additional information, see Section 8.1.5, “SQL Snippets tab”.

3.4 Tutorial: Add a Custom Link to the Home Page

This tutorial introduces the concept of altering the MySQL Workbench home screen by adding your own Shortcut link. Here we will add a shortcut titled "Example" that opens "example.org" as its own browser tab inside MySQL Workbench.

Note

Although adding a link to the Home screen is not a common need, this tutorial is an example that demonstrates the idea of customizing MySQL Workbench.

First, create an icon for your shortcut. This step is optional, and the table below compares the icon used in this tutorial and the default icon if a custom icon is not defined.

Table 3.3 MySQL Workbench Home Screen Icons

Default Icon	Our Example Icon

Save your new 52x52 pixel image to a location accessible by MySQL Workbench. By default, source icons are stored here:

Table 3.4 Default Path for Home Screen Icons

Operating System	File Path
Windows	"C:\Program Files (x86)\MySQL\MySQL Workbench CE 6.3.5\images\home\
OS X	/Applications/MySQLWorkbench.app/Contents/Resources/
Linux	/usr/share/mysql-workbench/images/

Next, open `starters_settings.xml` (this file is located under your user's MySQL Workbench directory) and add an entry for your new shortcut ID where the order determines the location on the Home screen. Follow the standard convention by appending your value to "com.mysql.wb.starter.", this tutorial uses "example":

```
<link type="object">com.mysql.wb.starter.example</link>
```

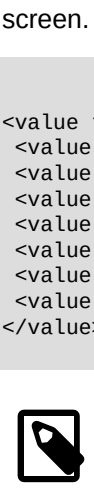
Lastly, open `predefined_starters.xml` and add a new "app.Starter" entry.

Table 3.5 Default Path to predefined_starters.xml

Operating System	File Path
Windows	"C:\Program Files (x86)\MySQL\MySQL Workbench CE 6.3.5\data\
OS X	/Applications/MySQLWorkbench.app/Contents/Resources/data/
Linux	/usr/share/mysql-workbench/data/

This tutorial does not describe this entry in detail, so consider it as a self-explanatory template for now. The important concepts include using the "id" you defined in the previous step, your own URL for the "command", and "smallIcon" as a 52x52 pixel image that is displayed on the MySQL Workbench home screen. Adjust these entries according to your needs, including the path to your icon.

```
<value type="object" struct-name="app.Starter" id="com.mysql.wb.starter.example">
 <value type="string" key="type">Website</value>
 <value type="string" key="title">Example</value>
 <value type="string" key="description">My wonderful example.org</value>
 <value type="string" key="publisher">Example Inc.</value>
 <value type="string" key="authorHome">http://www.example.org/about</value>
 <value type="string" key="smallIcon">/usr/local/share/wb-home-screen-example-icon.png</value>
 <value type="string" key="command">browse:http://example.org</value>
</value>
```

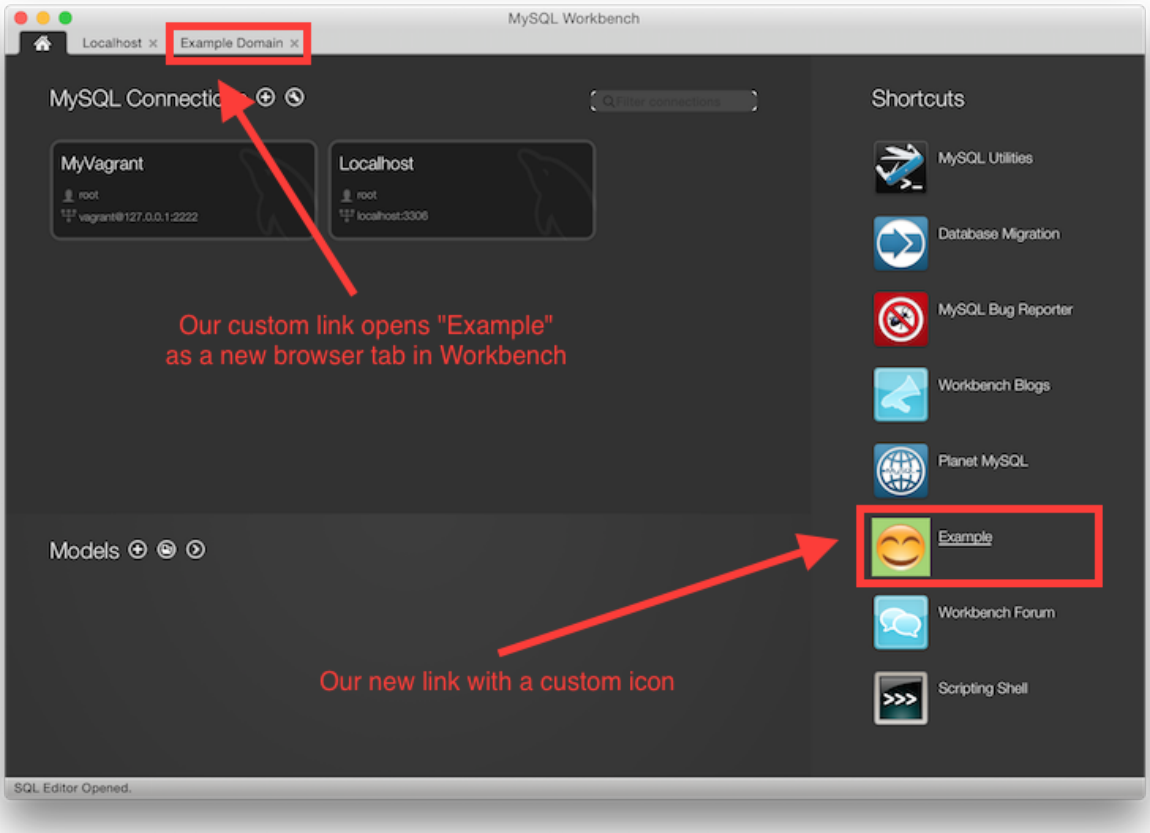


Note

Upgrading MySQL Workbench will overwrite these changes, because `predefined_starters.xml` is stored inside the MySQL Workbench installation directory, and `starters_settings.xml` is reset during installation. Consider saving copies of these changes for future reference.

Restart MySQL Workbench to see the new link on your MySQL Workbench home screen.

Figure 3.18 Home Screen with Custom Link



Additional "app.Starter" options include:

```
Require a specific edition of Workbench:
  Community:
    <value type="string" key="edition">ce</value>
  Commercial:
    <value type="string" key="edition">se</value>

Require a specific version (or higher) of Workbench:
  <value type="string" key="introduction">6.1.0</value>
```

3.5 Common Preferences and Configurations

Commonly used configuration options and preferences include:

- **Rescan for Local MySQL Instances**: Right-click on the Home screen, and this option will scan your system for MySQL instances and add connection tiles to the home screen.
- **Safe Updates**: When enabled (default), Workbench will not execute UPDATE or DELETE statements if a key is not defined in the WHERE clause. In other words, Workbench attempts to prevent big mistakes, such as deleting a large number of (or all) rows. Set from the **SQL Editor** preferences tab.

  For example, "DELETE FROM foo" is considered unsafe, whereas "DELETE FROM foo WHERE id = 1" is safe and will always execute.
- **Default Target MySQL Version**: For modeling, set this **Modeling** MySQL preference to your target MySQL Server version. This affects the generated syntax and database structure in relation to how MySQL changed over time. Having the wrong version may generate invalid syntax for your MySQL server.
- **Combine Management Tools and Schema Tree**: This refers to the left panel in the SQL Editor, where the **Management** and **Schemas** areas are on one or two separate tabs.

  This behavior can also be toggled at runtime by clicking the icon.
- **Save snapshot of open editors on close**: By default, Workbench saves all query tabs and reopens them when you restart Workbench. Use the related **Auto-save scripts interval** setting to modify its behavior. Both are set from the **SQL Editor** preferences tab.

  Related behavior: Right-click on an SQL tab and choose either Save tab (to save the tab to a file) or Close Other Tabs to close all other SQL editor tabs.
- **Enable Code Completion in Editors**: Code suggestions can be activated either manually, or automatically if the related **Automatically Start Code Completion** setting is also enabled. In addition, enable **Use UPPERCASE keywords on completion** to code suggest upper case SQL keywords, such as "INSERT" instead of "insert".

  Related behavior: The **Context Help** right panel in the SQL editor displays documentation for SQL statements, and is disabled/enabled from the right panel. For example, typing INSERT will load documentation for the INSERT statement in the right panel.

Chapter 4 The Home Screen

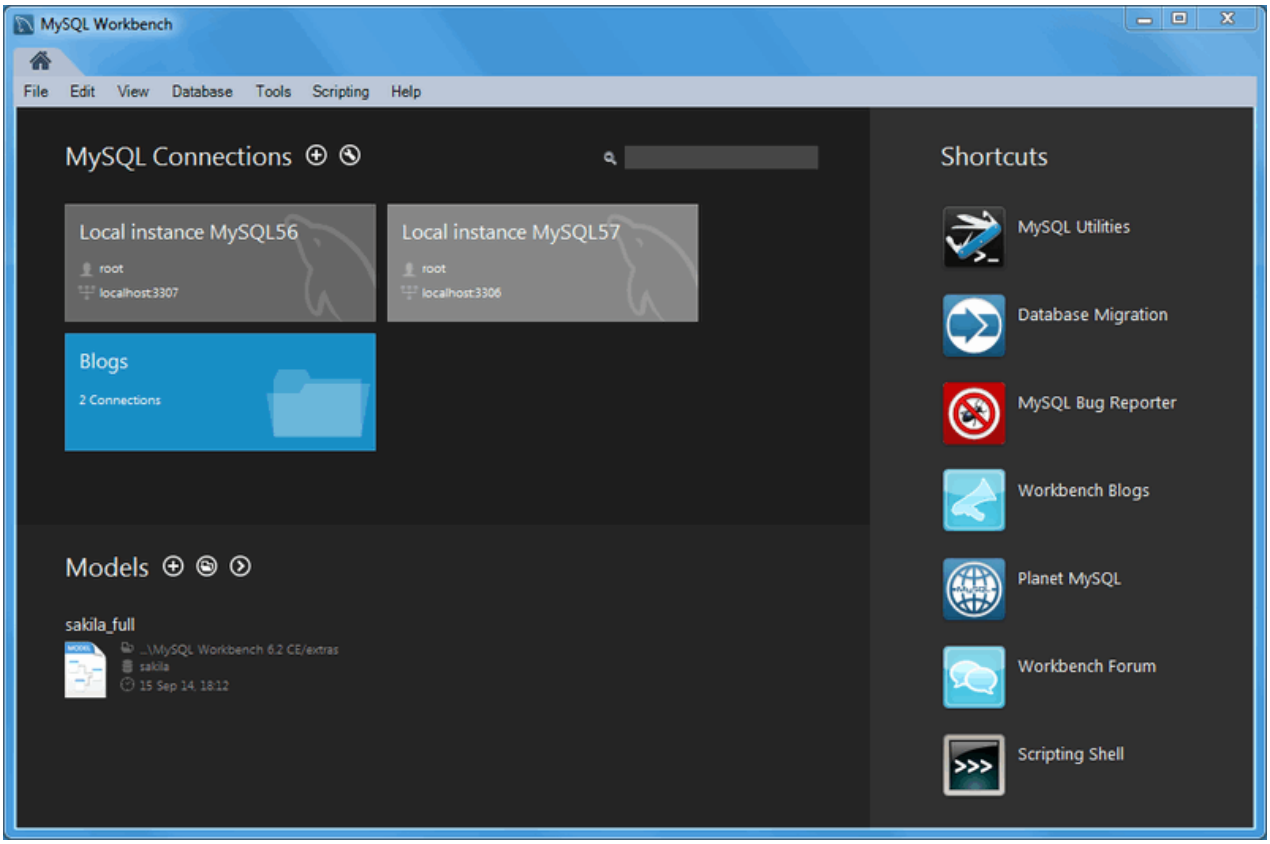
This is the first page you see when opening MySQL Workbench, and it is central to starting MySQL Workbench operations. The three main sections include the **MySQL Connections**, MySQL Workbench **Models**, and external **Shortcuts**.

Note

In MySQL Workbench 5.2 and below, the home screen was different and broken up into sections titled **SQL Development**, **Data Modeling**, and **Server Administration**. For additional information about this change, see Section 1.1.4, “New in MySQL Workbench 6.0”.

Most MySQL Workbench functionality, such as the SQL editor and MySQL server manager, begin with opening a MySQL connection from the home screen.

Figure 4.1 The Home Window



MySQL Connections

This section lists connections to all of your MySQL servers, and allows you to load, configure, group, and view information about each MySQL connection. For more information, see Chapter 5, *MySQL Connections* and Section 5.2, “Creating A New MySQL Connection (Tutorial)”.

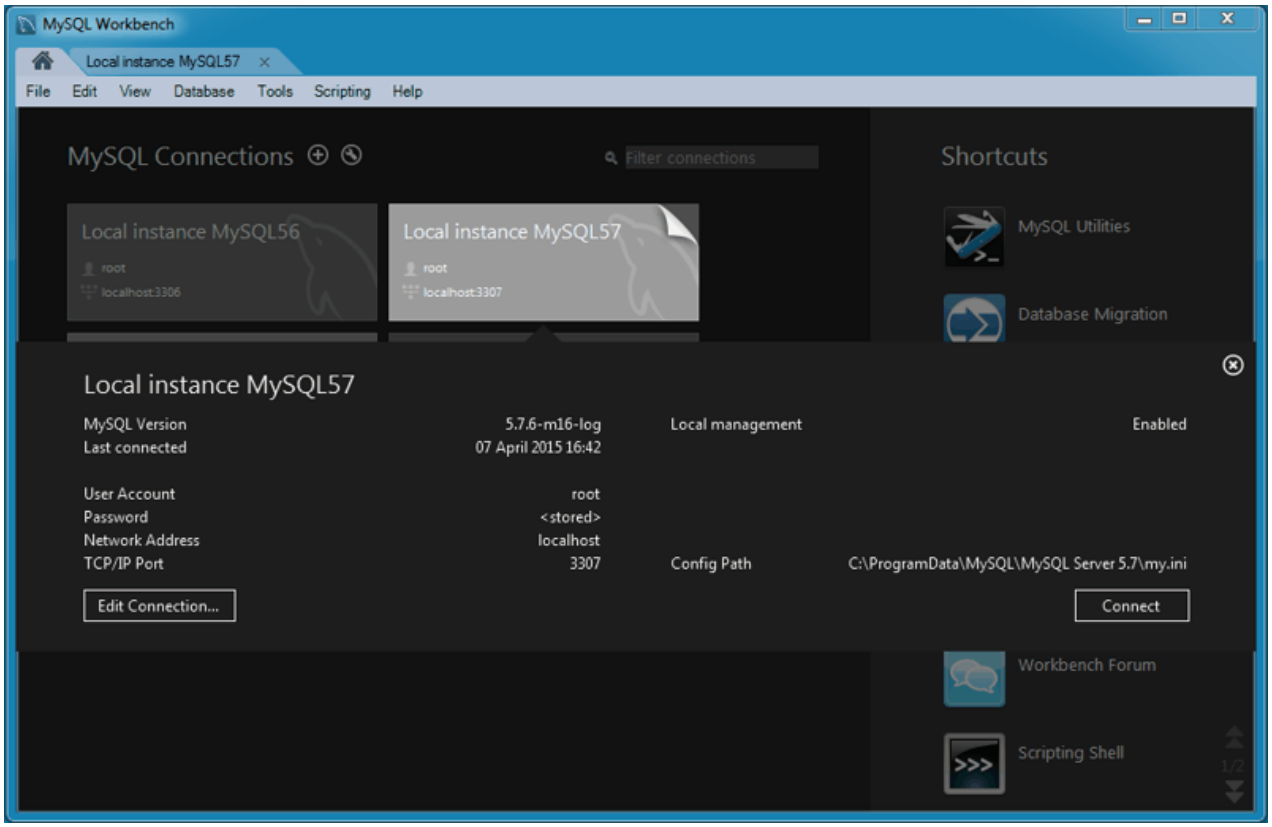
Connection Information

The method to view connection information depends on the operating system.

- On Microsoft Windows and Linux: hover over the right side of a connection title and click the title
- On OS X: hover over a connection title and click the little **(i)** in appears in the bottom right corner

The information will be displayed under the connection tiles, and will appear similar to:

Figure 4.2 Viewing Connection Information



Connection Groups

You may also create groups of connections. Create a group by either right-clicking a connection and choosing the Move to group... context menu option, or you may prefix your connection name with the group name separated by a forward slash (for example, "QA/TestBox") when you create or configure the connection.

Models

The **Models** panel your most recently used models. Each entry lists the date and time that the model was last opened, and its associated database. For further information about modeling, see Chapter 9, *Database Design / Modeling*.

To the right of the **Models** title are three icons. The (+) adds a new model, the (folder) opens an existing model from the disk, and the (>) opens a context menu for additional commands, such as **Create EER Model from Database**.

Workbench Shortcuts

Most of the options you can select on the home screen are straight-forward -- the ones that require explanation are detailed after the screenshot. Here is a quick overview of the simpler options that open your web browser to display information about

- **MySQL Utilities**: If the MySQL Utilities are installed, this opens the `mysqluc` utility. For additional information, see Appendix F, *MySQL Utilities*.
- **Database Migration**: Opens the migration wizard. For additional information, see Chapter 10, *Database Migration Wizard*.
- **MySQL Bug Reporter**: Lets you file a bug report in the MySQL bug system. For additional information, see Appendix D, *How To Report Bugs or Problems*.
- **Workbench Blogs**: Directs you to the Workbench team's blog.
- **Planet MySQL**: Points you to the general MySQL blog aggregator.
- **Workbench Forum**: Sends you to the user forums where you can ask questions and interact with other MySQL Workbench users.
- **Scripting Shell**: Execute Python scripts and develop MySQL Workbench plugins.
- **Oracle eDelivery**: Sends you to your MySQL Workbench downloads (Commercial).
- **Oracle Support**: Sends you to your MOS (My Oracle Support) page (Commercial).

Chapter 5 MySQL Connections

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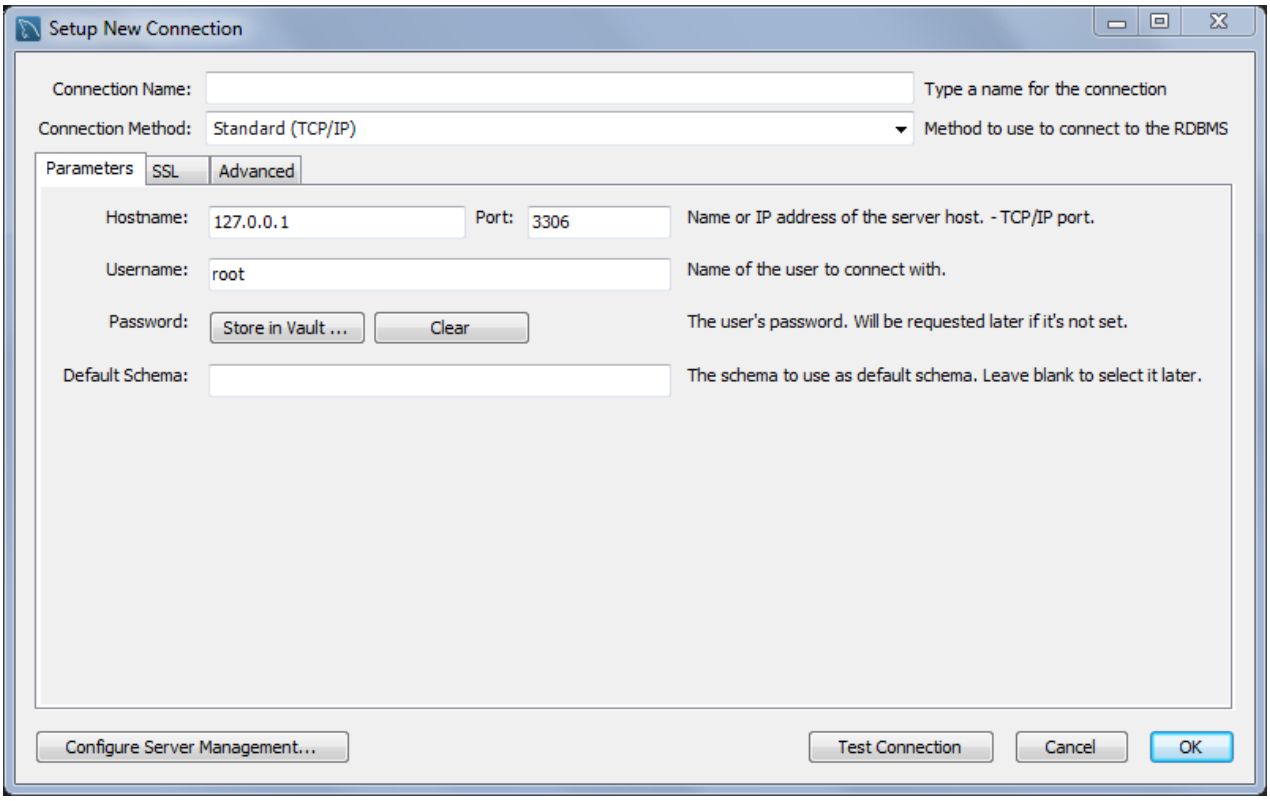
Manage and create MySQL connections.

5.1 Creating A New MySQL Connection (Simple)

To add a connection, click the [+] icon to the right of the **MySQL Connections** title on the Home screen. This opens the **Setup New Connection** form:

Figure 5.1 Setup New Connection Form



Important

The Configure Server Management button (bottom left) opens an optional configuration wizard for setting shell commands on the host. For example, commands to start/stop the MySQL instance, or to edit configuration file. For more information, see Section 5.3.6, “Configure Server Management Wizard”.

Fill out the connection details and optionally click Configure Server Management to execute the Server Management wizard. Click OK to save the connection.

Important

When opening connections, MySQL Workbench automatically sets the client character set to `utf8`. Manually changing the client character set, such as using `SET NAMES ...`, may cause MySQL Workbench to not correctly display the characters. For additional information about client character sets, see Connection Character Sets and Collations.

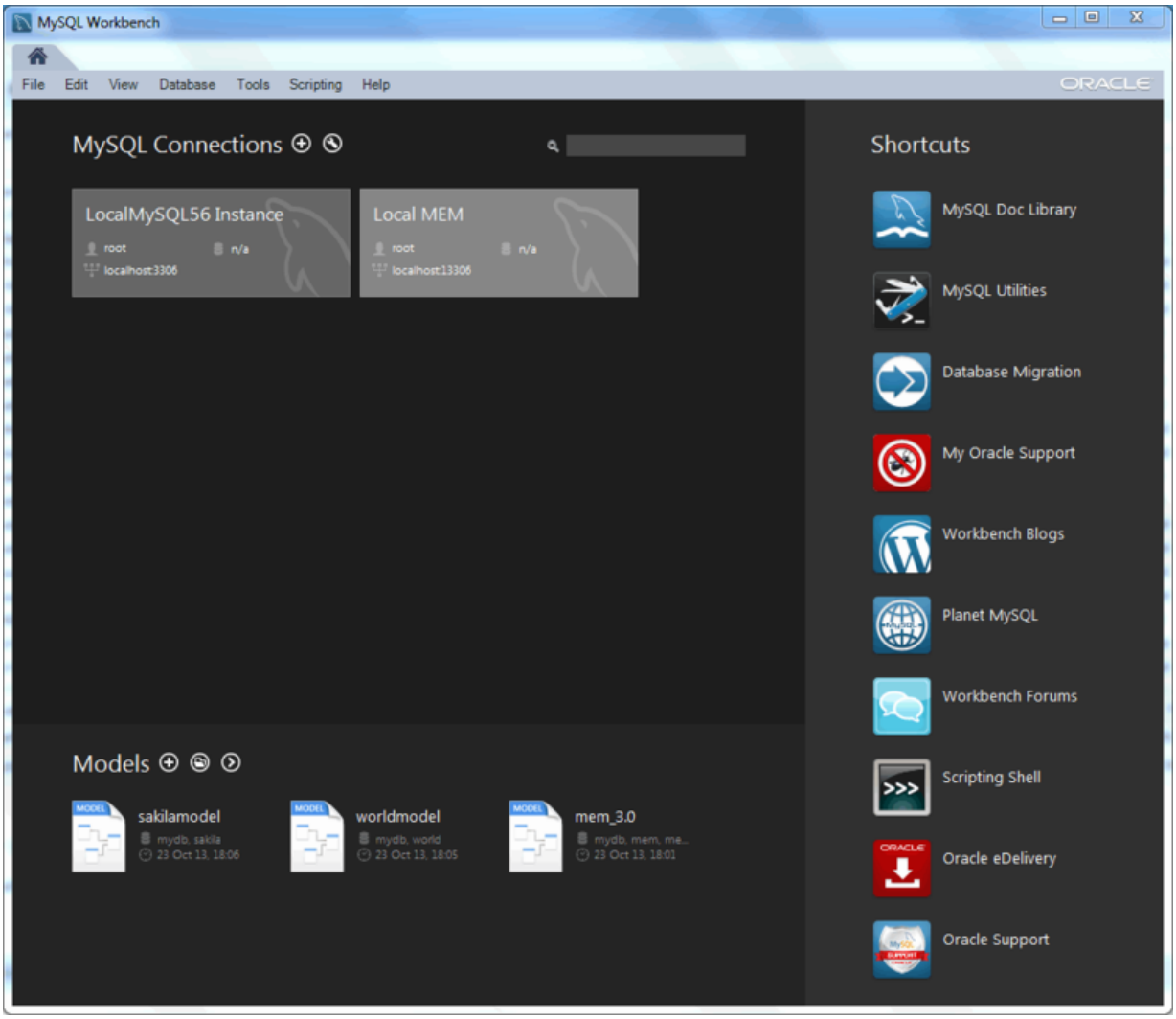
New MySQL connections are added to the Home screen as a tile, and the Section 8.2.1, “Object Browser and Editor Navigator” describes several MySQL Workbench features to monitor and configure each connected MySQL server. A single MySQL Workbench instance can open one or multiple MySQL connections into individual tabs.

For a more detailed overview of this process, see the tutorial titled Section 5.2, “Creating A New MySQL Connection (Tutorial)”.

5.2 Creating A New MySQL Connection (Tutorial)

1. Launch MySQL Workbench. You will be presented with the Home window.

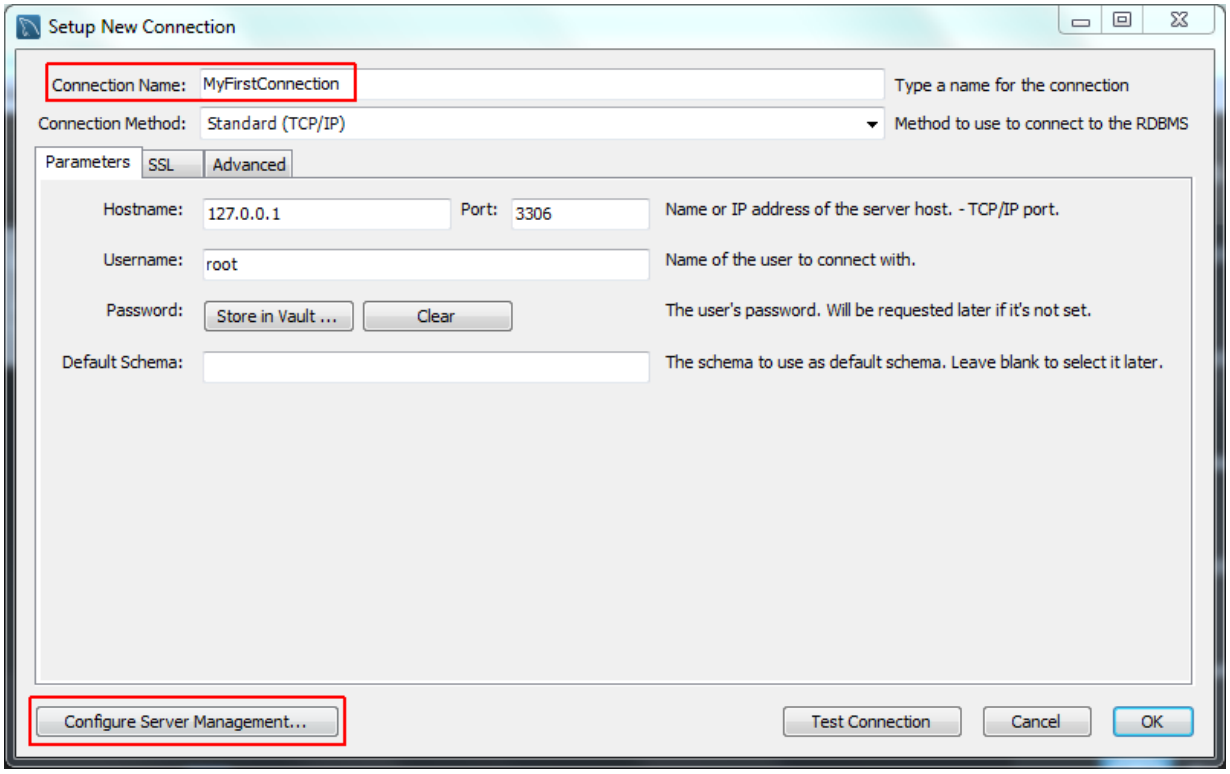
Figure 5.2 Getting Started Tutorial - Home Window



2. Our example already has two connections created, but let us create a new connection. From the MySQL Workbench Home window, click the **[+]** icon near the **MySQL Connections** label. This opens the **Setup New Connection** wizard.

3. Define the **Connection Name** value, which we will set to "MyFirstConnection" in this example.

Figure 5.3 Getting Started Tutorial - Setup New Connection: MyFirstConnection

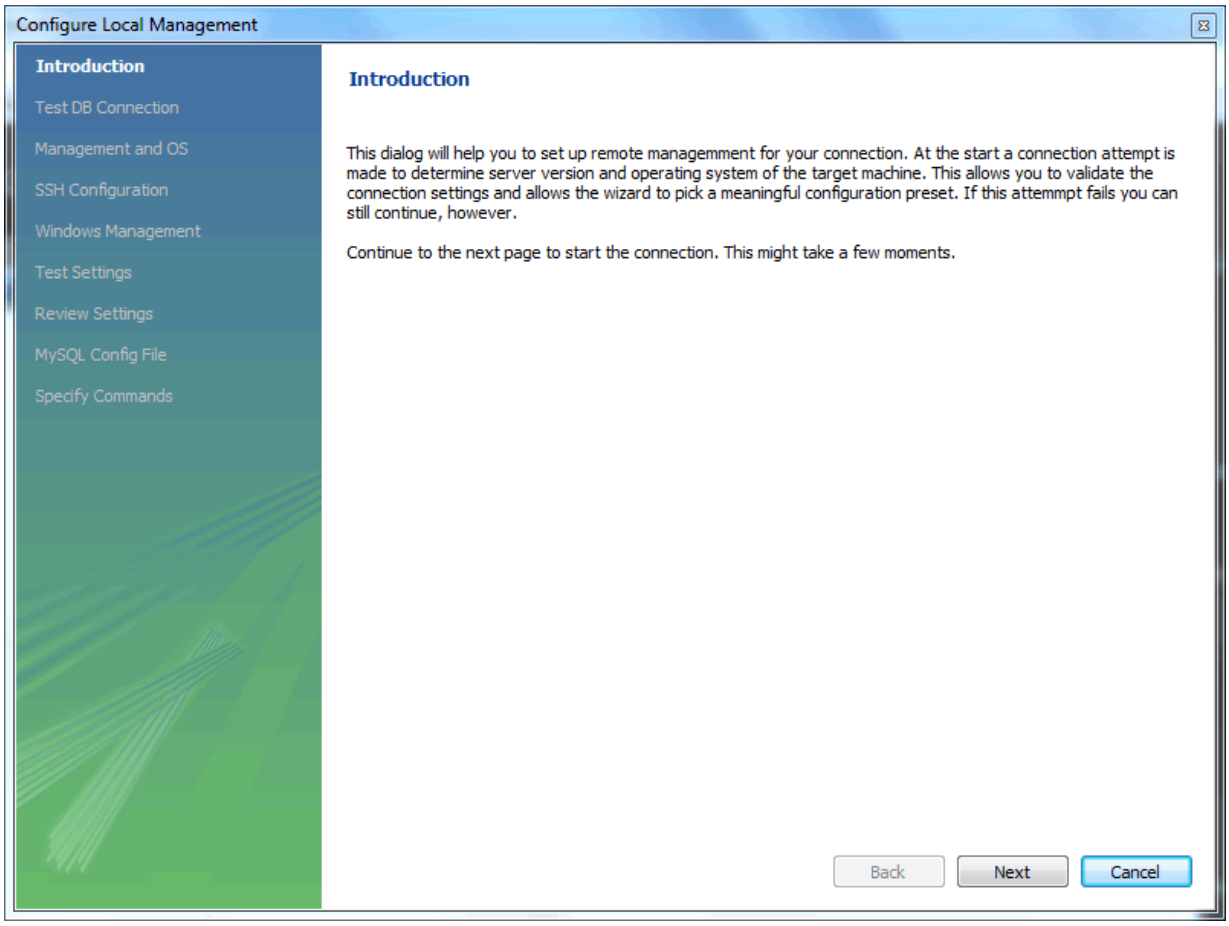


The default connection values are for a typical local setup, so check them and enter the appropriate values. If you are unsure, click the Test Connection button to check the connection parameters. Do not press OK.

Next, optionally click Configure Server Management..., which opens up the **Configure Local Management** wizard:

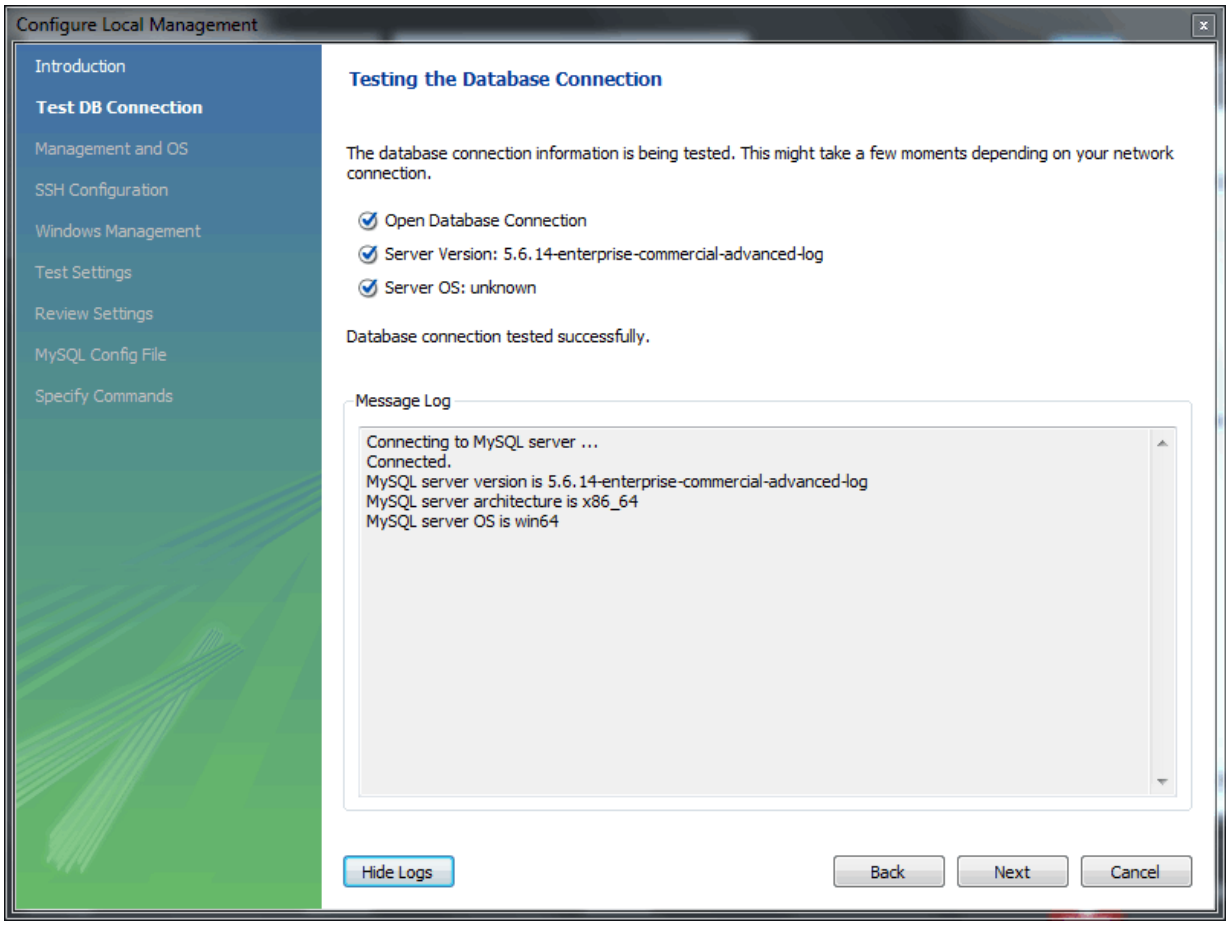
4. Read the **Configure Local Management** introduction, and press Next to begin defining the new connection parameters.

Figure 5.4 Getting Started Tutorial - Configure Local Management Introduction


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Introduction
This dialog will help you to set up remote managemment for your connection. At the start a connection attempt is made to determine server version and operating system of the target machine. This allows you to validate the connection settings and allows the wizard to pick a meaningful configuration preset. If this attemmpt fails you can still continue, however.
Continue to the next page to start the connection. This might take a few moments.
Back
Next
Cancel

5. The connection will now be tested. You should see that the connection was successful. If not, click Back and check that you have entered the information correctly.

Figure 5.5 Getting Started Tutorial - Test Database Connection



Toggle the Show Logs to view additional details about the tested connection, then click Next.

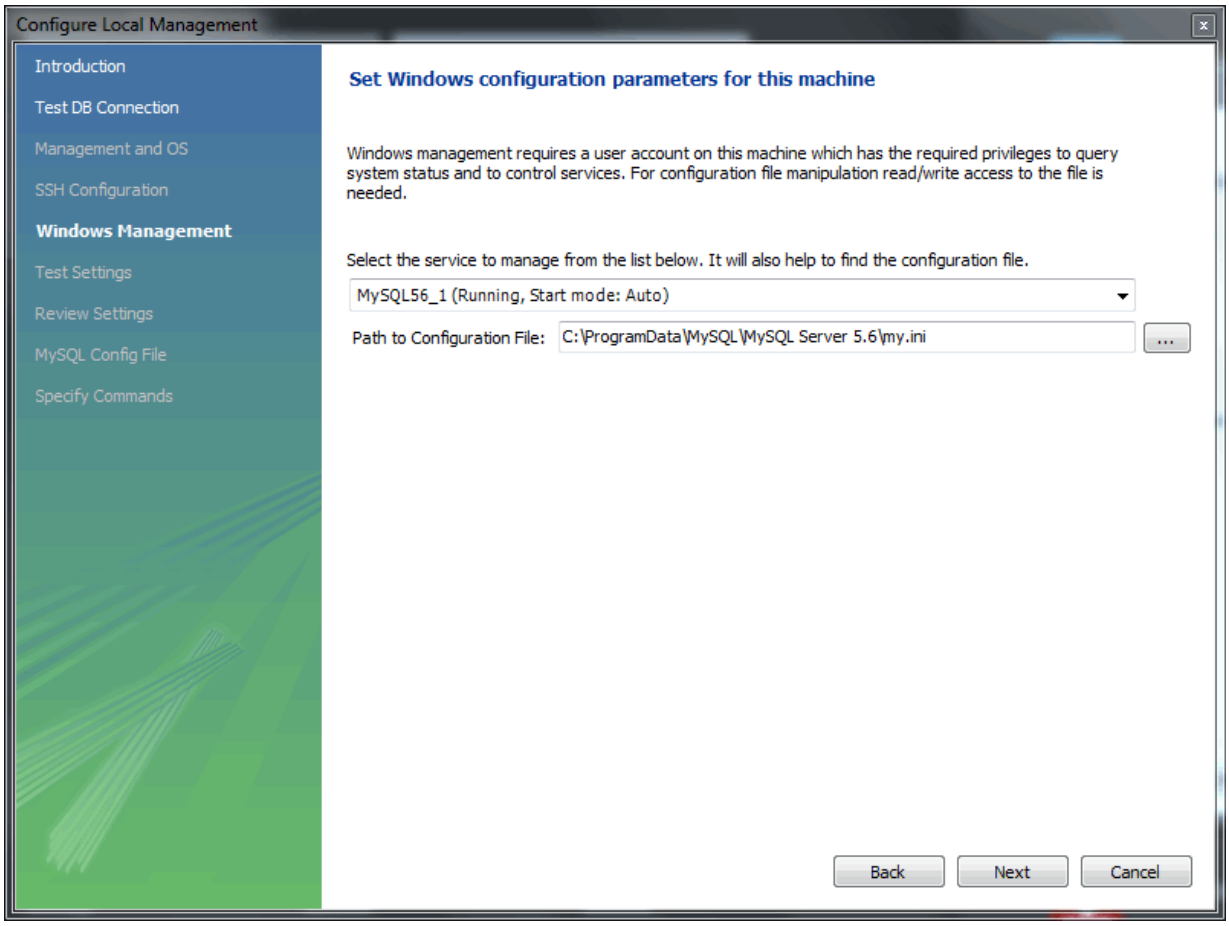
6. Optionally, you may configure a method for remote management if a Remote Host was specified. Setting these options enables MySQL Workbench to determine the location of configuration files, and the correct start and stop commands to use for the connection.

   SSH login based management and Native Windows remote management types are available. The Operating System and MySQL Installation Type are configured for the SSH login variant.

   We are creating a local MySQL connection in this tutorial, so are skipping the **Management and OS** and **SSH Configuration** options, as they are used for configuring a remote MySQL connection.

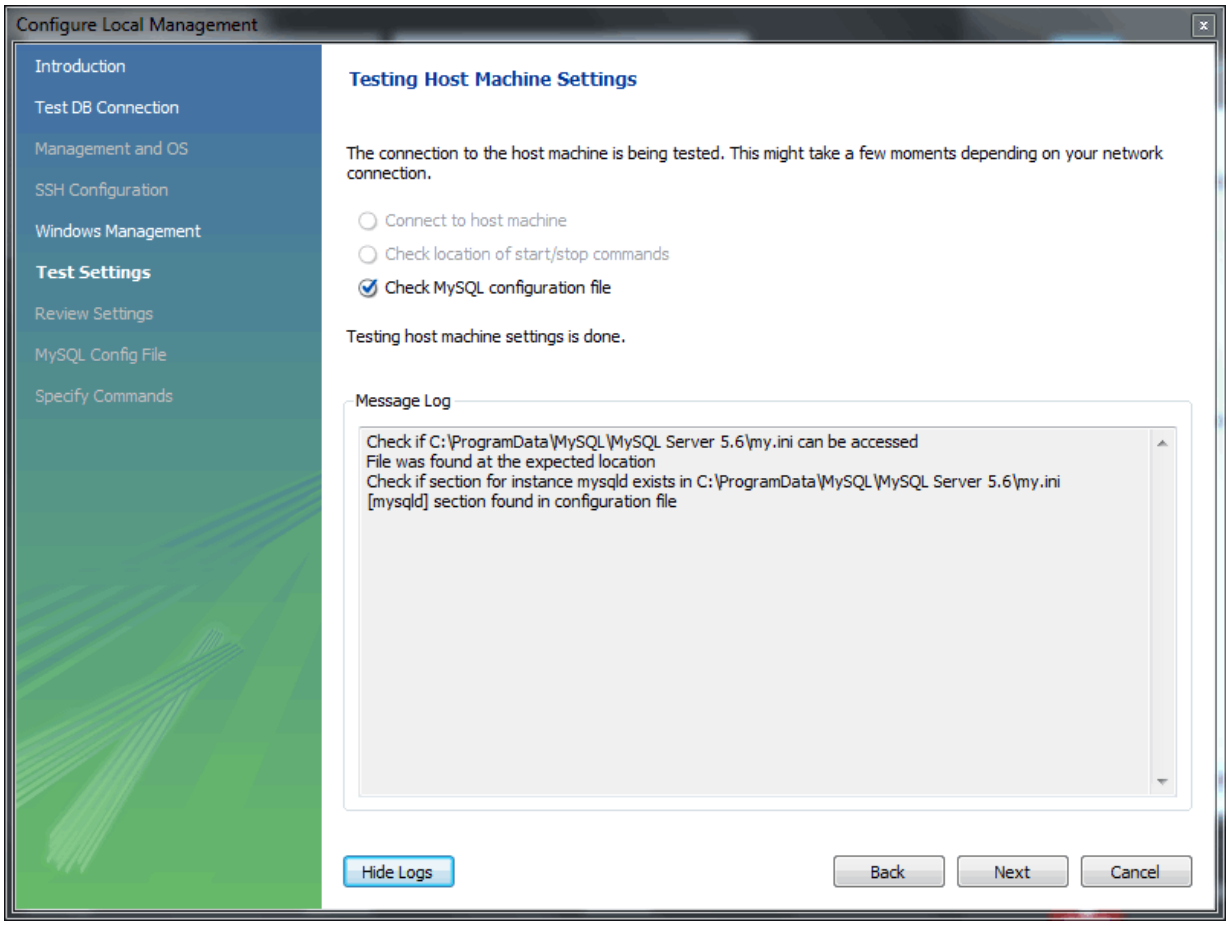
7. On Microsoft Windows, select the appropriate MySQL service for the MySQL connection.

Figure 5.6 Getting Started Tutorial - Windows Management


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Set Windows configuration parameters for this machine
Windows management requires a user account on this machine which has the required privileges to query system status and to control services. For configuration file manipulation read/write access to the file is needed.
Select the service to manage from the list below. It will also help to find the configuration file.
MySQL56_1 (Running, Start mode: Auto)
Path to Configuration File:
C:\ProgramData\MySQL\MySQL Server 5.6\my.ini
...
Back
Next
Cancel

8. The wizard will now check its ability to access the start and stop commands, and check access to the MySQL Server configuration file.

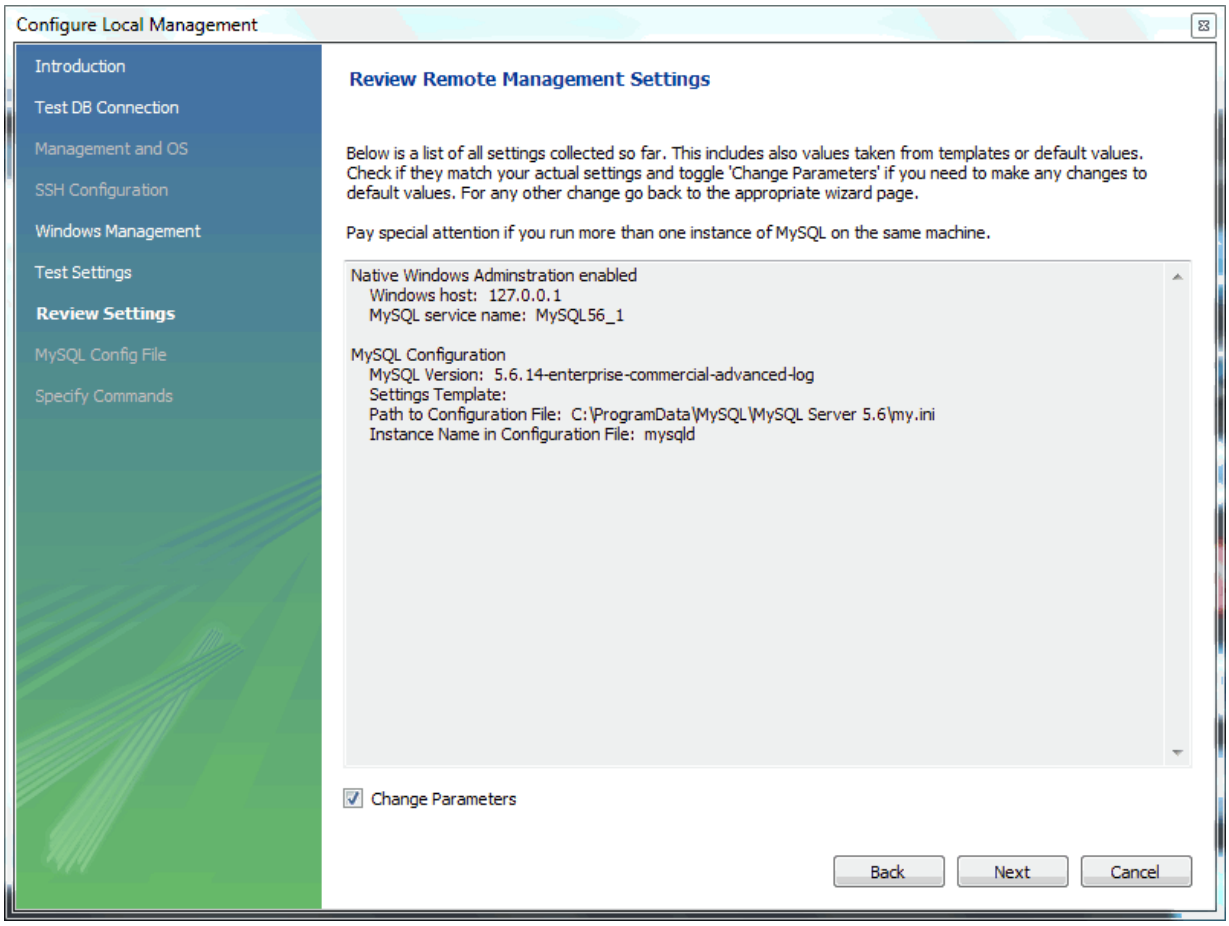
Figure 5.7 Getting Started Tutorial - Test Settings


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Testing Host Machine Settings
The connection to the host machine is being tested. This might take a few moments depending on your network connection.
Connect to host machine
Check location of start/stop commands
Check MySQL configuration file
Testing host machine settings is done.
Message Log
Check if C:\ProgramData\MySQL\MySQL Server 5.6\my.ini can be accessed
File was found at the expected location
Check if section for instance mysqld exists in C:\ProgramData\MySQL\MySQL Server 5.6\my.ini
[mysqld] section found in configuration file
Hide Logs
Back
Next
Cancel

9. You now have a chance to review the configuration settings. The information displayed varies slightly depending on platform, connection method, and installation type.

   At the **Review Settings** prompt, choose "I'd like to review the settings again" to review the settings. Choosing "Continue" closes the "Configure Server Management" dialog.

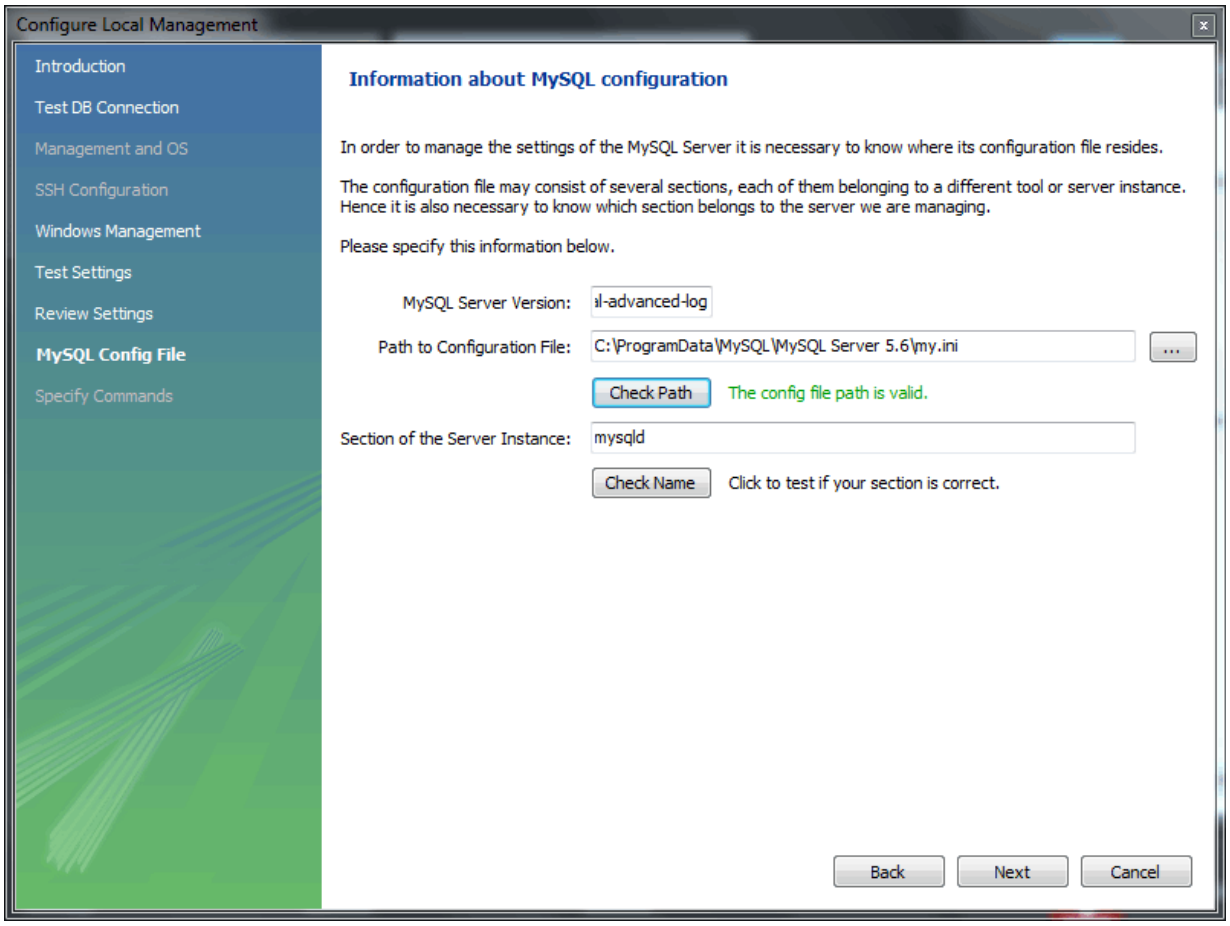
Figure 5.8 Getting Started Tutorial - Review Settings


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Review Remote Management Settings
Below is a list of all settings collected so far. This includes also values taken from templates or default values. Check if they match your actual settings and toggle 'Change Parameters' if you need to make any changes to default values. For any other change go back to the appropriate wizard page.
Pay special attention if you run more than one instance of MySQL on the same machine.
Native Windows Adminstration enabled
Windows host: 127.0.0.1
MySQL service name: MySQL56_1
MySQL Configuration
MySQL Version: 5.6.14-enterprise-commercial-advanced-log
Settings Template:
Path to Configuration File: C:\ProgramData\MySQL\MySQL Server 5.6\my.ini
Instance Name in Configuration File: mysqld
Change Parameters
Back
Next
Cancel

Check the **Change Parameters** if you want to check or edit information about the MySQL configuration file. In our example we will check it, and click Next to continue.

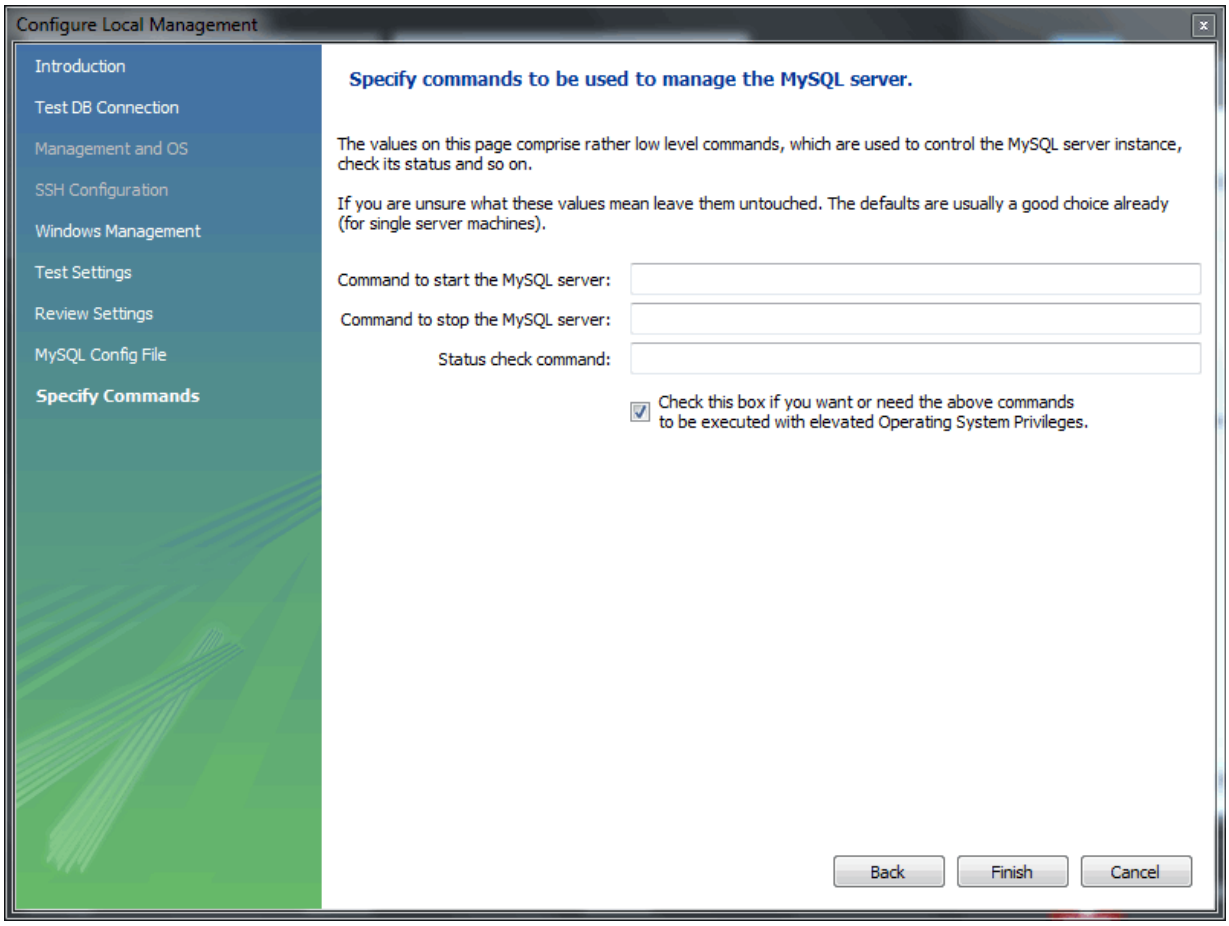
10. Review the MySQL configuration file information. Click the **Check** buttons to perform the described checks, or optionally change the configuration file path.

Figure 5.9 Getting Started Tutorial - MySQL Config File


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Information about MySQL configuration
In order to manage the settings of the MySQL Server it is necessary to know where its configuration file resides.
The configuration file may consist of several sections, each of them belonging to a different tool or server instance.
Hence it is also necessary to know which section belongs to the server we are managing.
Please specify this information below.
MySQL Server Version:
al-advanced-log
Path to Configuration File:
C:\ProgramData\MySQL\MySQL Server 5.6\my.ini
...
Check Path
The config file path is valid.
Section of the Server Instance:
mysqld
Check Name
Click to test if your section is correct.
Back
Next
Cancel

11. Optionally, enter your own commands for starting, stopping, and checking the MySQL connection. Typically the default values are used, which means leaving these optional values blank.

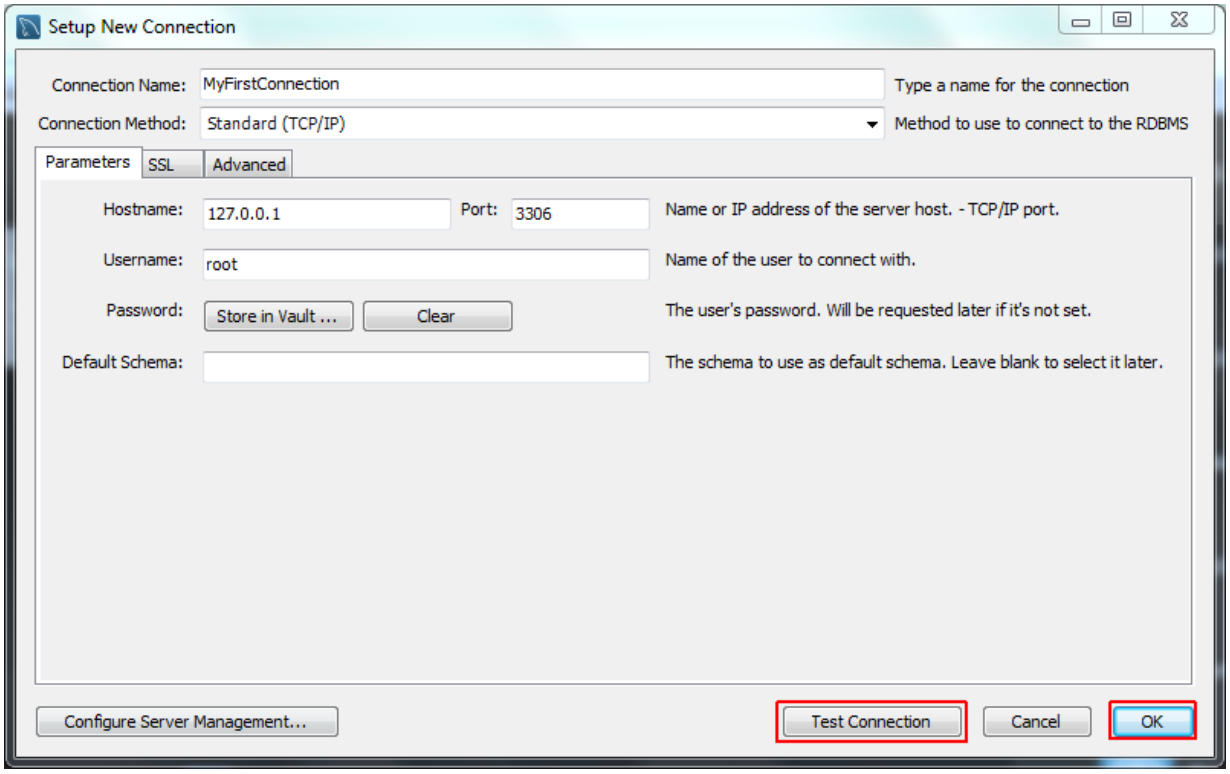
Figure 5.10 Getting Started Tutorial - Specify Commands


Configure Local Management
Introduction
Test DB Connection
Management and OS
SSH Configuration
Windows Management
Test Settings
Review Settings
MySQL Config File
Specify Commands
Specify commands to be used to manage the MySQL server.
The values on this page comprise rather low level commands, which are used to control the MySQL server instance, check its status and so on.
If you are unsure what these values mean leave them untouched. The defaults are usually a good choice already (for single server machines).
Command to start the MySQL server:
Command to stop the MySQL server:
Status check command:
Check this box if you want or need the above commands to be executed with elevated Operating System Privileges.
Back
Finish
Cancel

Click Finish to close the "Configure Server Management" dialog, which reveals the original **Setup New Connection** window.

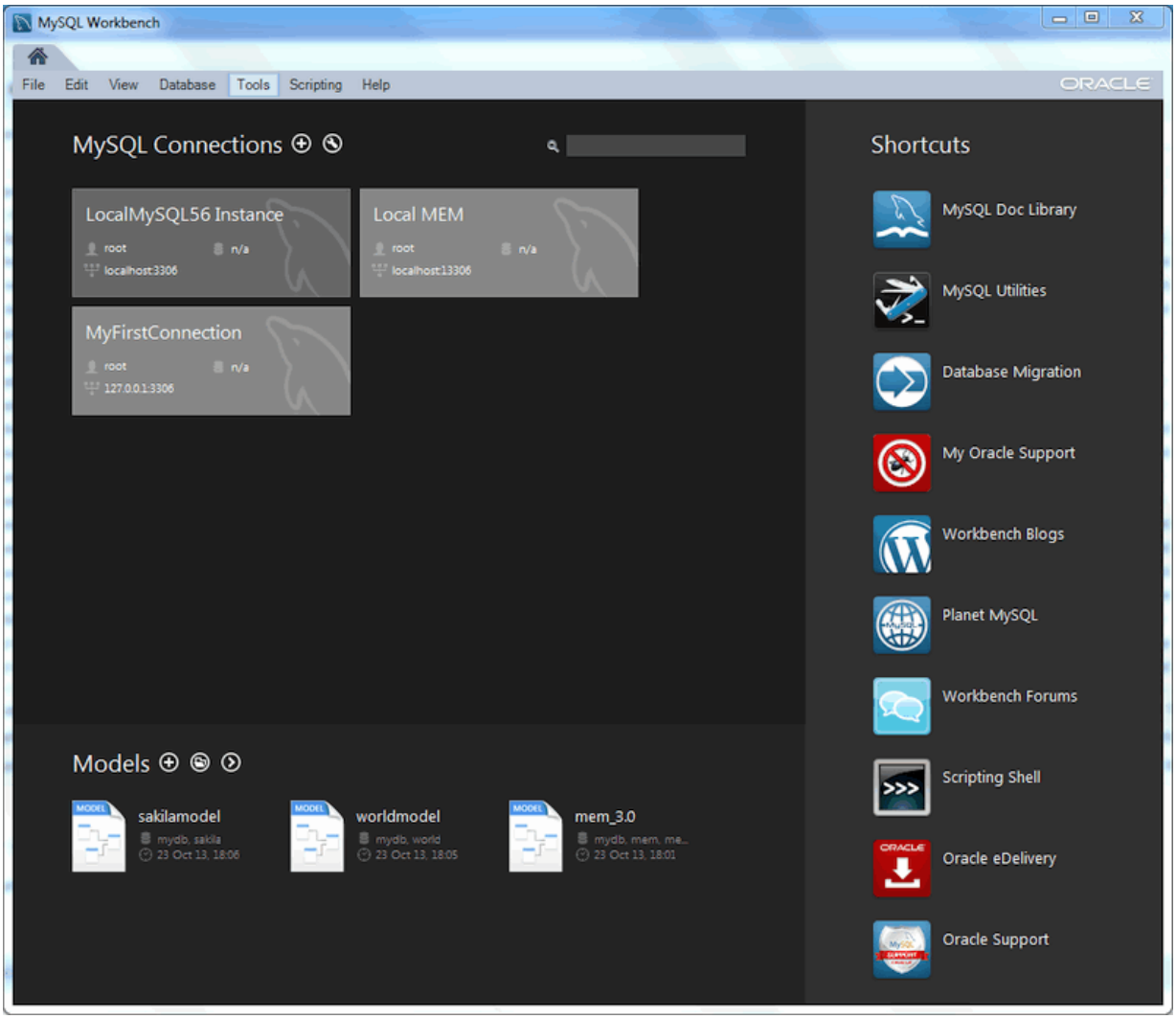
12. After reviewing the **Setup New Connection** information, press Test Connection again to make sure it still functions, and then OK to create the new MySQL connection.

Figure 5.11 Getting Started Tutorial - Setup New Connection



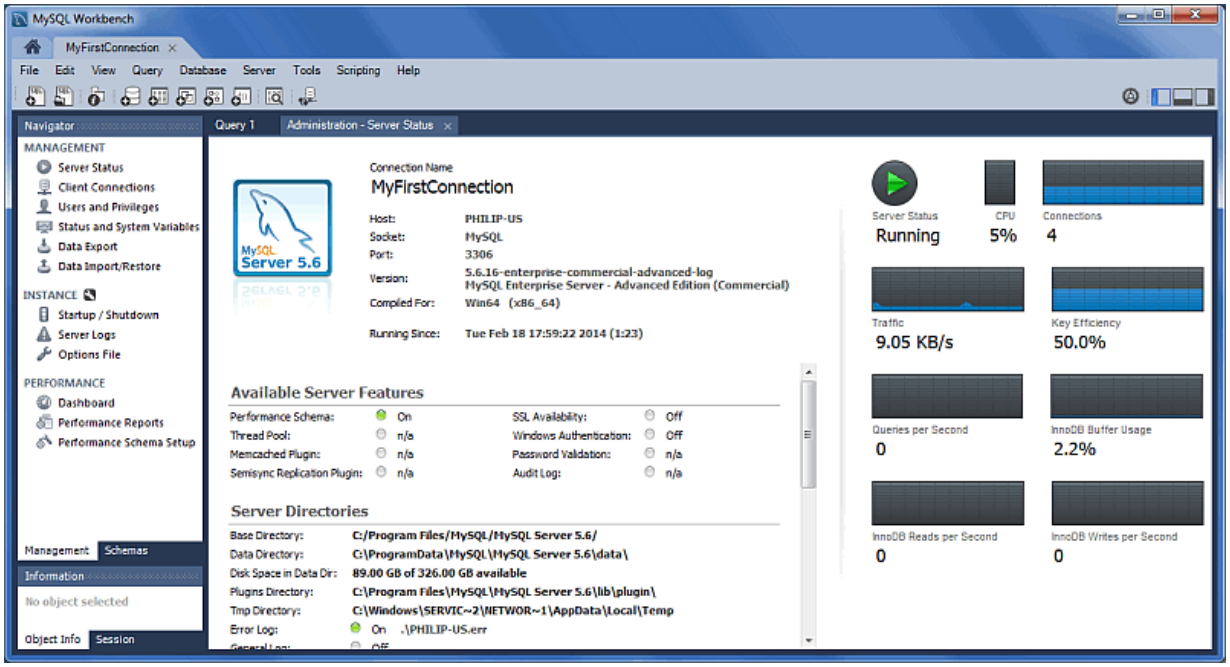
13. Your new **MyFirstConnection** MySQL connection is now listed on the Home window.

Figure 5.12 Getting Started Tutorial - Home Window Instance



14. From the Home window, click the new MySQL connection to open the SQL editor for this connection. The SQL editor is the default page, so now select the **Server Status** from the left **Navigator** panel to display the connected MySQL server's current status.

Figure 5.13 Getting Started Tutorial - Server Status



15. Test the other **Navigator** panel options that relate to your new MySQL connection. Check its status, MySQL logs, and measure its performance statistics from the **Dashboard**.

    Notice the **Management** and **Schemas** tabs on the bottom of the **Navigator** panel. The **Schemas** view displays the schemas that are associated with your new MySQL connection. Alternatively, you can merge the Schemas and Management tabs by either clicking the merge icon on the top right of the Navigator panel, or by enabling the **Show Management Tools and Schema Tree in a single tab** SQL Editor preference.

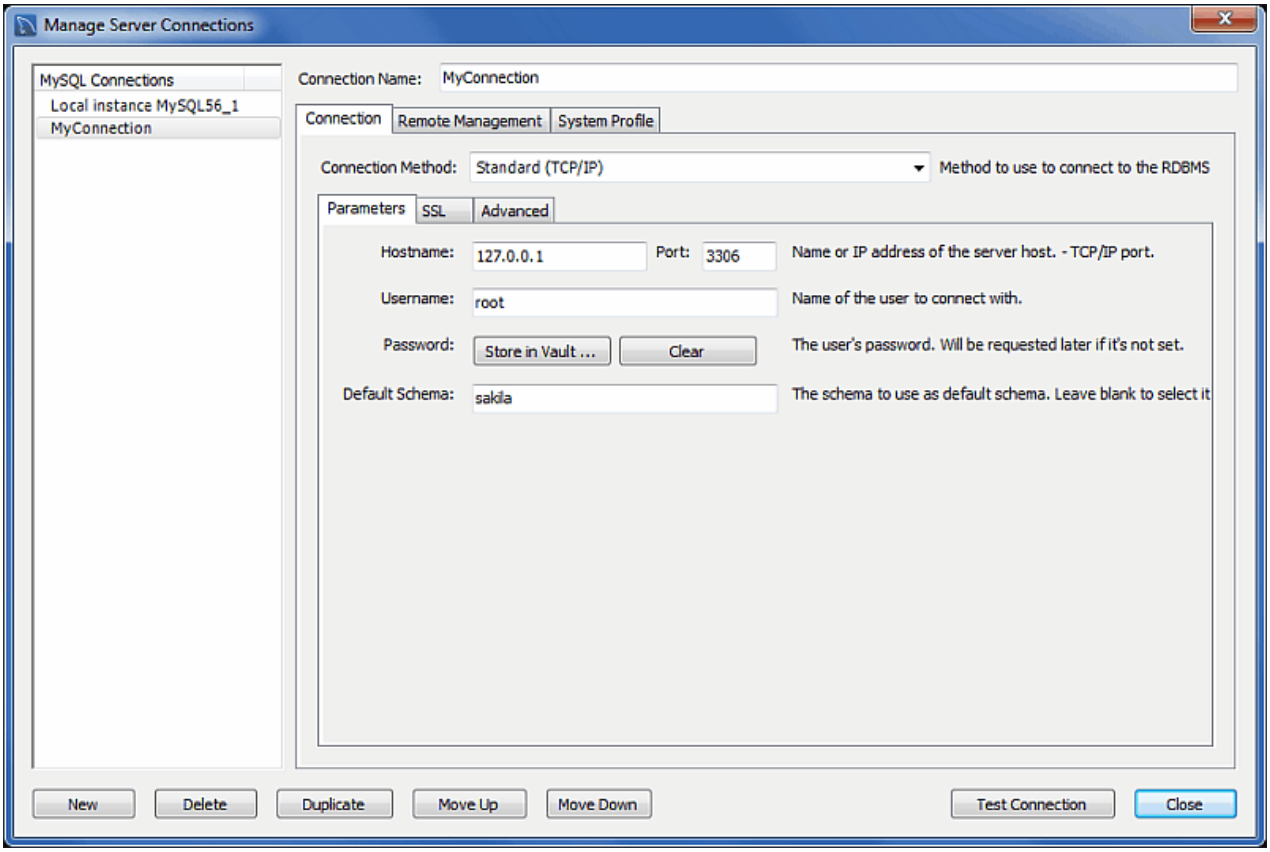
This concludes the "Creating a MySQL connection" tutorial. For additional information about MySQL connections, see Chapter 5, *MySQL Connections*.

5.3 Manage Server Connections

The **Manage Server Connections** dialog is another way to manage MySQL connections. This dialog is invoked by either selecting **Edit Connection** or selecting Database, Manage Connections from the main menu. It can also be invoked from any of the wizards requiring access to a live database.

After the MySQL connection manager is launched, you are presented with the following dialog, with the **Connection** tab open:

Figure 5.14 Manage Server Connections: Connection Tab



- **Connection Name**: The name used to refer to this connection. This connection can then be selected from a list in other wizards requiring a connection.
- **Connection Method**: Method used to connect to the RDBMS.

  After you select a connection method, the fields available in the **Parameters**, **SSL**, and **Advanced** tabs change accordingly. More details about these options and parameters are available below.

Note

The Test Connection button will test the selected MySQL connection and report its connection status. It also reports whether or not SSL is enabled.

For testing remote connections, you might also use `ping` to check the hostname, or `telnet` to also check the port. If these fail, then also check the firewall settings on each host, and also that MySQL server is running on the remote host.

Note

Simultaneous client connections: Opening a MySQL connection from the MySQL Workbench home page opens a new connection tab in MySQL Workbench for that connection. Each of these tabs requires two MySQL connections to perform basic tasks, such schema discovery and SQL execution. Additionally, performing management related tasks, such as **Server Status**, requires two additional MySQL connections. Essentially, this means that each MySQL connection tab in MySQL Workbench requires four available connections to MySQL. For

additional information about "Too many connection" related errors, see Too many connections.

This connection requirement doubles with each connection tab opened in MySQL Workbench, even if the two connection tabs point to the same MySQL server. SQL editor tabs share their connections, so having multiple SQL editor and SQL results tabs does not affect the number of required connections.

5.3.1 Standard TCP/IP Connection Method

This connection method enables MySQL Workbench to connect to MySQL Server using TCP/IP.

Note

The `--skip-networking` MySQL server configuration option affects the TCP/IP connection method. If disabled, use named pipes or shared memory (on Windows) or Unix socket files (on Unix).

Parameters tab

- **Hostname**: The host name or IP address of the MySQL server.

Note

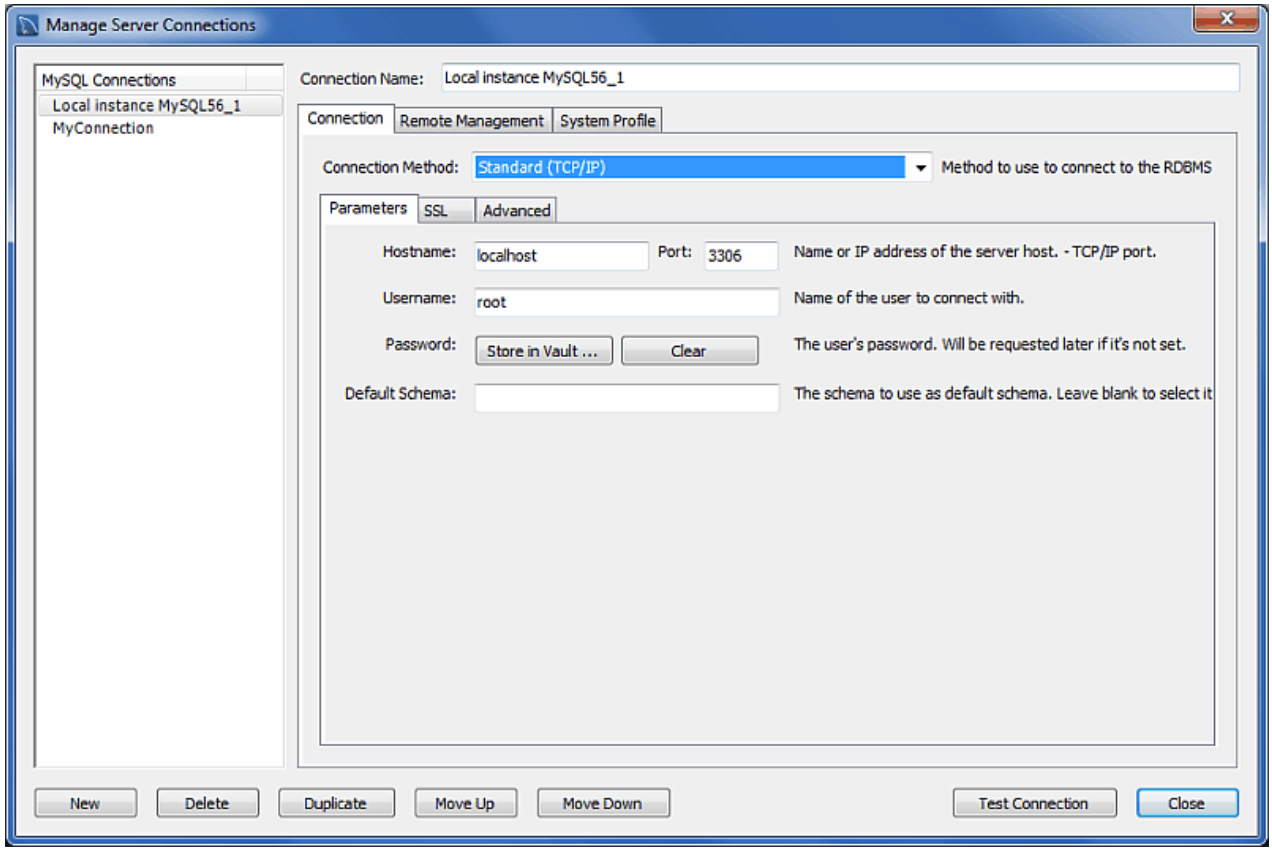
The host name "localhost" might resolve to "127.0.0.1" or "::1" on your host, so note this when checking permissions. For example, if a web application's user only has access to "127.0.0.1" on a host, and a defined connection uses "localhost" that resolves to "::1", this connection may lack the proper permissions to the aforementioned web application. Ping "localhost" on each host to determine where it resolves to.

- **Port**: The TCP/IP port on which the MySQL server is listening (the default is 3306).
- **Username**: User name to use for the connection.
- **Password**: Optional password for the account used. If you enter no password here, you will be prompted to enter the password when MySQL Workbench attempts to establish the connection. MySQL Workbench can store the password in a vault (see Section 5.3.7, “The Password Storage Vault”).
- **Default Schema**: When the connection to the server is established, this is the schema that will be used by default. It becomes the default schema for use in other parts of MySQL Workbench.

Advanced tab

Advanced parameters are less common and include:

Figure 5.15 Standard (TCP/IP) Connection: Advanced Tab



The **Advanced** tab includes these check boxes:

- **Use compression protocol**: If checked, the communication between the application and the MySQL server will be compressed, which may increase transfer rates. This corresponds to starting a MySQL command-line client with the `--compress` option. This option is unchecked by default.
- **Use ANSI quotes to quote identifiers**: Treat “"” as an identifier quote character (like the “`” quote character) and not as a string quote character. You can still use “`” to quote identifiers with this mode enabled. With this option enabled, you cannot use double quotation marks to quote literal strings, because it is interpreted as an identifier. Note: If this option is checked, it overrides the server setting. This option is unchecked by default.
- **Enable Cleartext Authentication Plugin**: Send the user password in cleartext. Required for some authentication methods. This option is unchecked by default.
- **Use the old authentication protocol**: This option disables Connector/C++'s secure_auth option. This option is unchecked by default.

It also includes these options:

SQL_MODE: Override the default `SQL_MODE` used by the server.

Others: Other options for Connector/C++ as option=value pairs, one per line.

SSL tab

SSL parameters include:

- **Use SSL**: This dropdown provides options related to enabling SSL encryption. Choose **No** to disable SSL, **If available** if the client library supports it, or **Require** to require SSL support for the MySQL connection to succeed. This option defaults to **If available**.
- **SSL CA File**: Path to the Certification Authority file for SSL.
- **SSL CERT File**: Path the Certificate file for SSL.
- **SSL Key File**: Path to the Key file for SSL.
- **SSL Cipher**: Optional list of permissible ciphers to use for SSL encryption.
- SSL Wizard: Generate SSL certificates for both the MySQL server and MySQL client. Requires access to OpenSSL binaries in the system's PATH. For additional information, see Section 5.3.4, “SSL Wizard (Certificates)”.
- Files: Opens a system's file browser that points to the generated SSL files by the SSL Wizard.

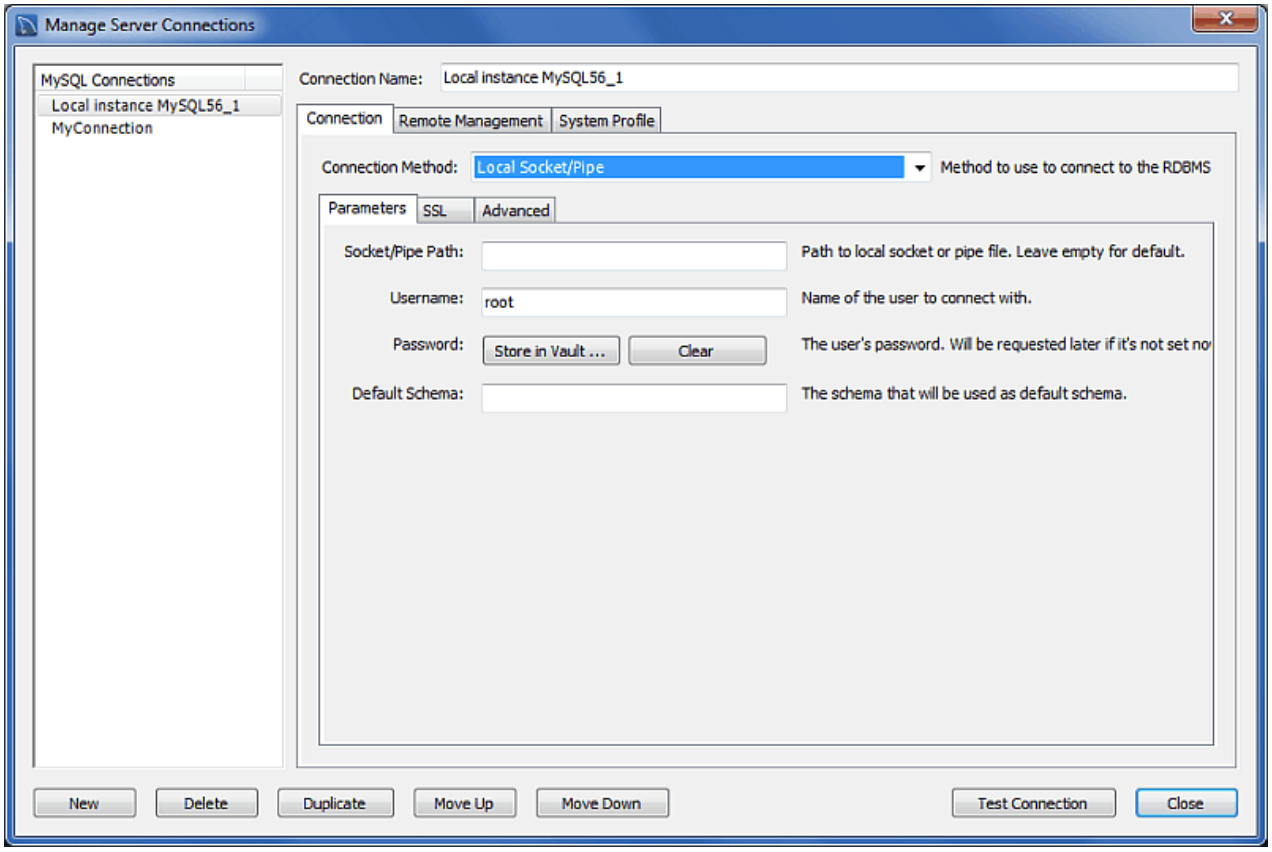
5.3.2 Local Socket/Pipe Connection Method

This connection method enables MySQL Workbench to connect to MySQL Server using a socket file (on Unix) or a named pipe (on Windows).

Parameters

The unique field here is **Socket/Pipe Path**. Enter the name of the socket or pipe here. If the field is left blank, the default socket or pipe name is used. On Unix, the default socket name is `/tmp/mysql.sock`. On Microsoft Windows, the default pipe name is `MySQL`.

Figure 5.16 Manage DB Connections - Socket/Pipe Parameters



Advanced

These are the same options discussed in Section 5.3.1, “Standard TCP/IP Connection Method”, except there is not the **Use compression protocol** option.

SSL

These are the same options discussed in Section 5.3.1, “Standard TCP/IP Connection Method”.

5.3.3 Standard TCP/IP over SSH Connection Method

This connection method enables MySQL Workbench to connect to MySQL Server using TCP/IP over an SSH connection.

Parameters

In addition to a number of parameters that are in common with Standard TCP/IP connections, this connection method features a number of specialized parameters. These are listed here:

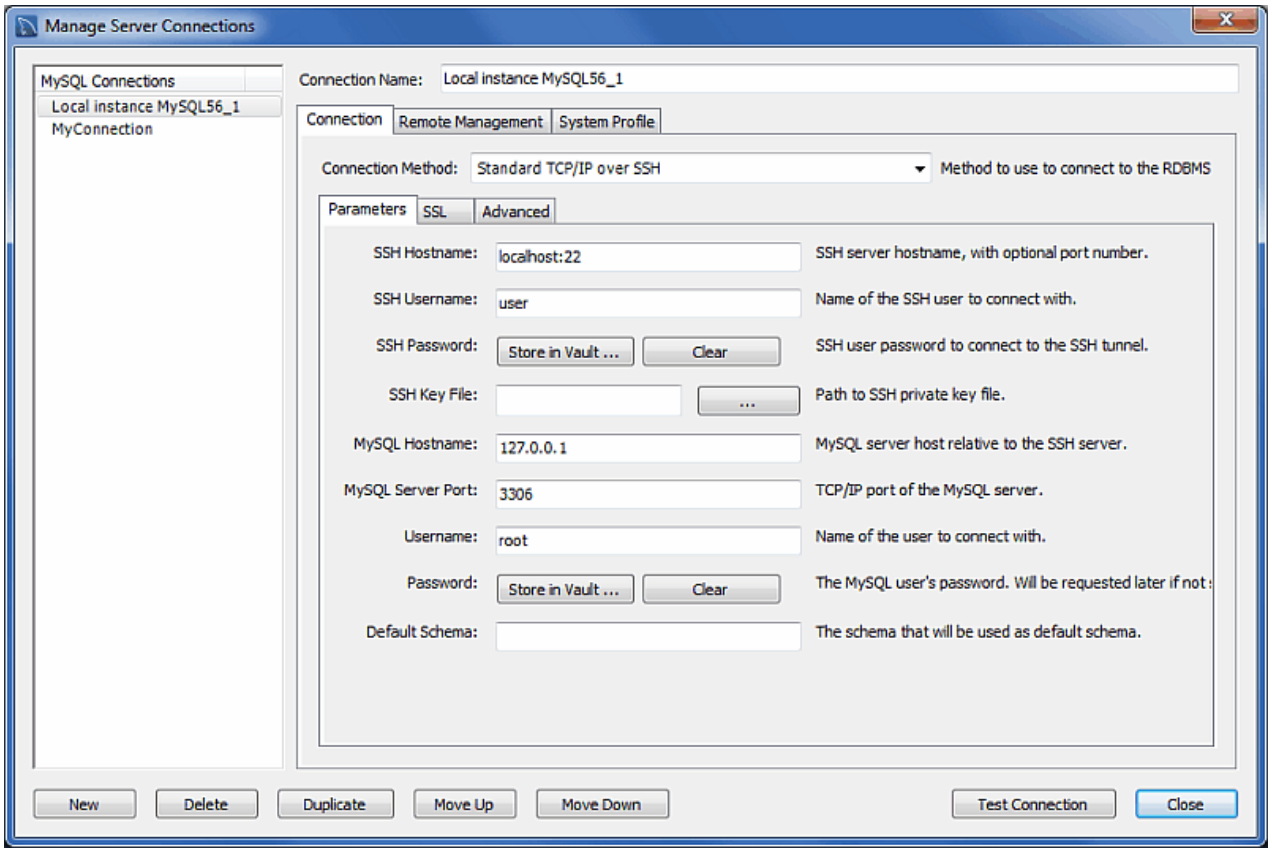
- **SSH Hostname**: This is the name of the SSH server. An optional port number can also be provided. For example, localhost:22.
- **SSH Username**: This is the name of the SSH user name to connect with.
- **SSH Password**: The SSH password. It is recommended that an SSH key file is also used.
- **SSH Key File**: A path to the SSH key file.

If a remote host is missing from the system's list of known hosts, a prompt requires you to confirm the host's fingerprint before storing it. If your stored host fingerprint is different than the host's current fingerprint, then an error is generated and you will be required to handle the discrepancy from outside of MySQL Workbench before creating the connection. Prior to MySQL Workbench 6.1.6, the host SSH fingerprint was not saved by MySQL Workbench.

On Linux and OS X, SSH host fingerprints are stored in `~/.ssh/known_hosts`. On Microsoft Windows, they are stored in a file created by MySQL Workbench under the user's application data folder (`%appdata%`), such as `C:\Users\[username]\AppData\Roaming\MySQL\Workbench\known_hosts`.

The SSH connection options are viewable in the following screenshot:

Figure 5.17 Manage DB Connections - SSH Parameters



Advanced

The options here are the same as for the Standard TCP/IP connection. See Section 5.3.1, “Standard TCP/IP Connection Method”.

SSL

The options here are the same as for the Standard TCP/IP connection. See Section 5.3.1, “Standard TCP/IP Connection Method”.

5.3.4 SSL Wizard (Certificates)

This wizard helps create SSL certificates for both MySQL clients and MySQL servers. Connections in MySQL Workbench are updated with the certificates by the wizard. This wizard requires OpenSSL to create the certificates. An example `my.cnf` / `my.ini` file is also generated that utilizes the generated certificates.

Note

The OpenSSL binary should be in the system's PATH.

Figure 5.18 SSL Wizard: Welcome

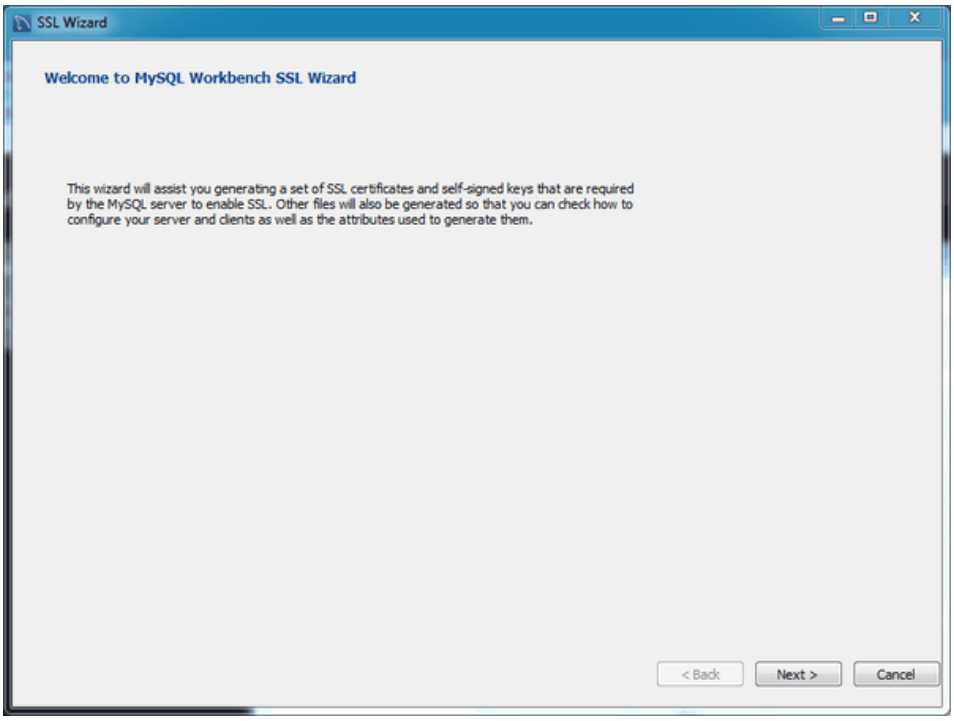

SSL Wizard
Welcome to MySQL Workbench SSL Wizard
This wizard will assist you generating a set of SSL certificates and self-signed keys that are required by the MySQL server to enable SSL. Other files will also be generated so that you can check how to configure your server and clients as well as the attributes used to generate them.
< Back
Next >
Cancel

Figure 5.19 SSL Wizard: Options

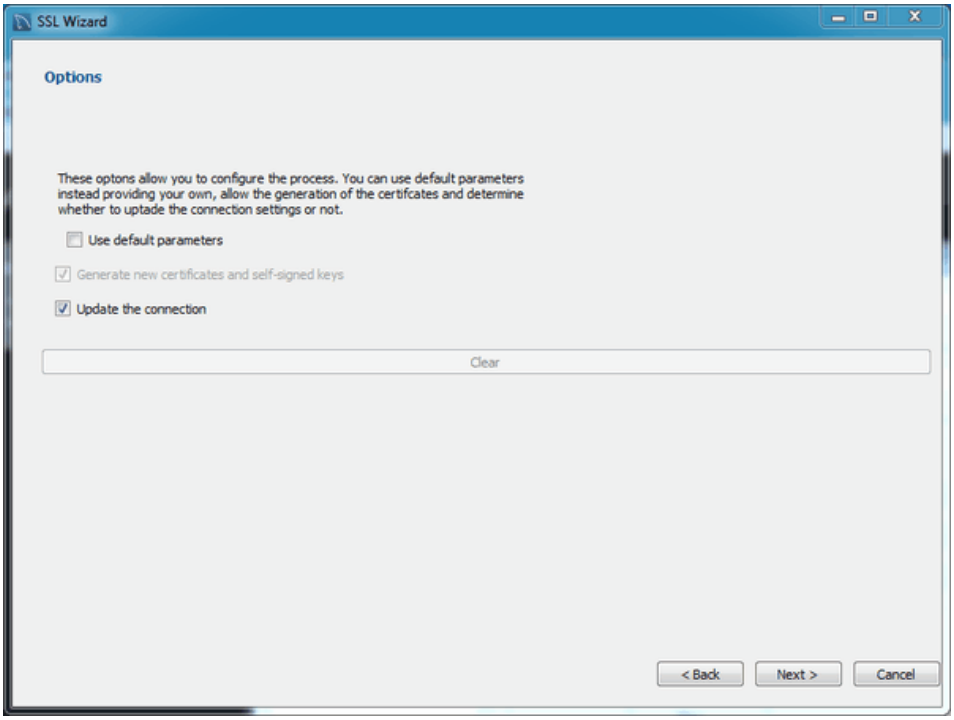
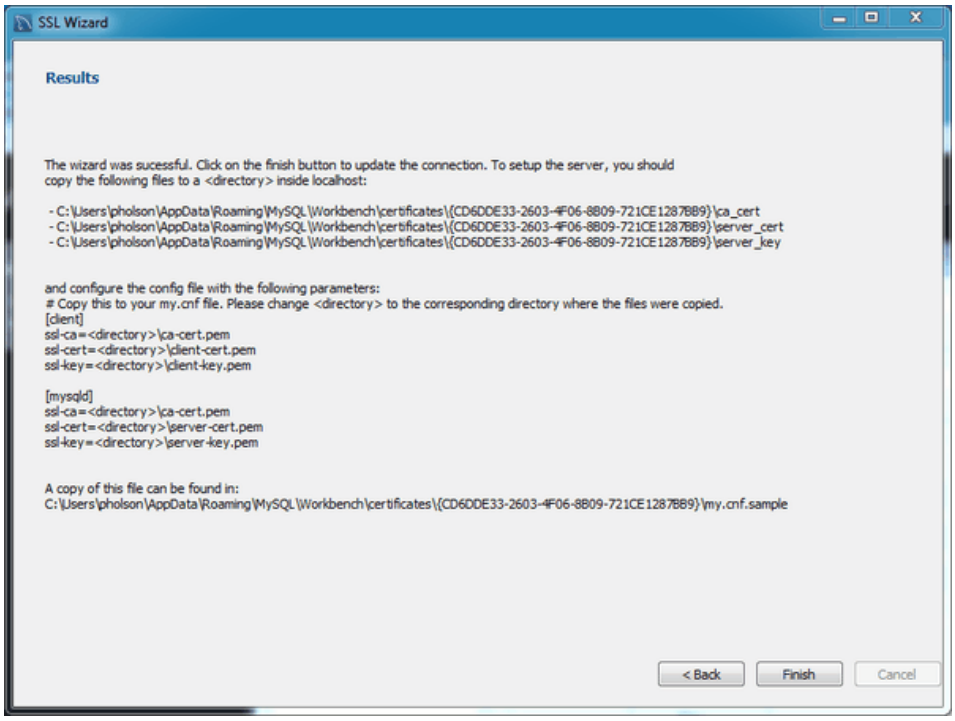

SSL Wizard
Options
These optons allow you to configure the process. You can use default parameters instead providing your own, allow the generation of the certifcates and determine whether to uptade the connection settings or not.
Use default parameters
Generate new certificates and self-signed keys
Update the connection
Clear
< Back
Next >
Cancel

Figure 5.20 SSL Wizard: Results


SSL Wizard
Results
The wizard was sucessful. Click on the finish button to update the connection. To setup the server, you should copy the following files to a <directory> inside localhost:
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\ca_cert
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\server_cert
- C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\server_key
and configure the config file with the following parameters:
Copy this to your my.cnf file. Please change <directory> to the corresponding directory where the files were copied.
[client]
ssl-ca=<directory>\ca-cert.pem
ssl-cert=<directory>\client-cert.pem
ssl-key=<directory>\client-key.pem
[mysqld]
ssl-ca=<directory>\ca-cert.pem
ssl-cert=<directory>\server-cert.pem
ssl-key=<directory>\server-key.pem
A copy of this file can be found in:
C:\Users\pholson\AppData\Roaming\MySQL\Workbench\certificates\{CD6DDE33-2603-4F06-8B09-721CE1287BB9}\my.cnf.sample
< Back
Finish
Cancel

5.3.5 System Profile

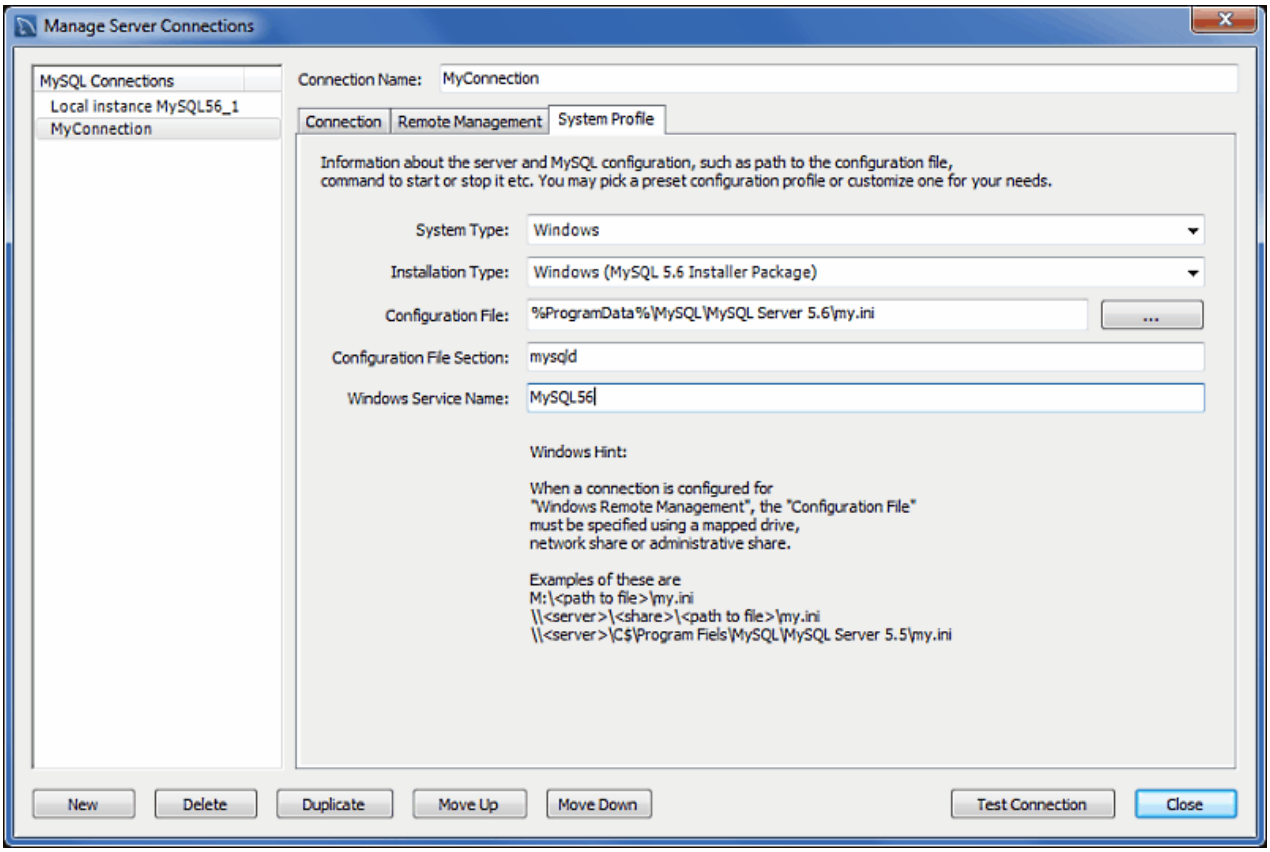
The **System Profile** tab enables you to specify host-specific information. This is achieved primarily through selecting a **System Type**, along with its corresponding **Installation Type**. These profile settings contain standard information that is used in managing the host's MySQL instance.

Here are some of the available installation types:

- FreeBSD, MySQL package or Custom
- Linux, including distributions such as Fedora, Oracle, RHEL, SLES, Ubuntu, Generic, and Custom
- OS X, MySQL package or Custom
- OpenSolaris, MySQL package or Custom
- Windows, with different installation methods, MySQL versions, and build architectures

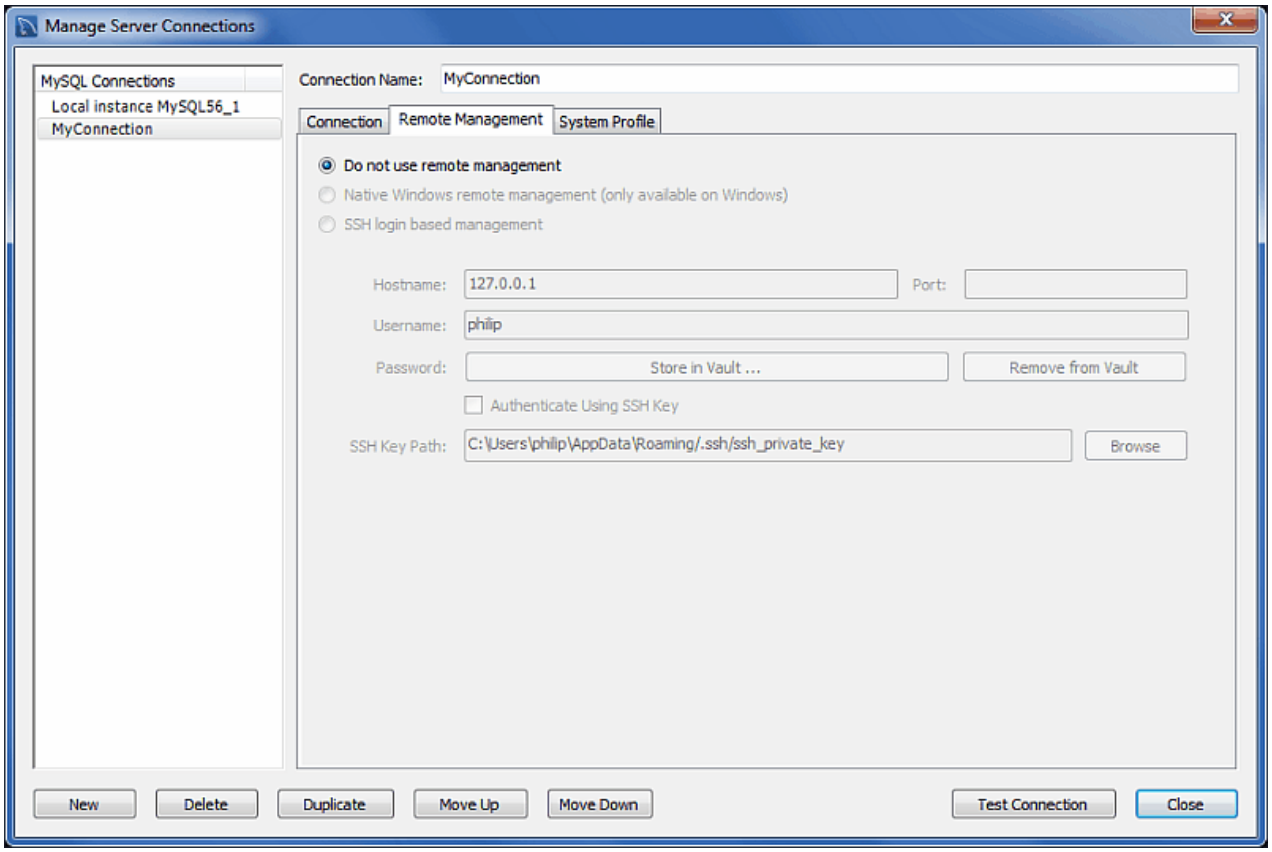
Choose the appropriate **System Type** and **Installation Type** to set default parameters that includes commands used to start and stop MySQL, commands to check the server status, the location of the `my.ini` or `my.cnf` configuration file, and on Windows, the Windows Service Name. These default values are customizable.

Figure 5.21 Manage Server Connections: System Profile Tab



The **Remote Management** tab is available when connecting to MySQL remotely.

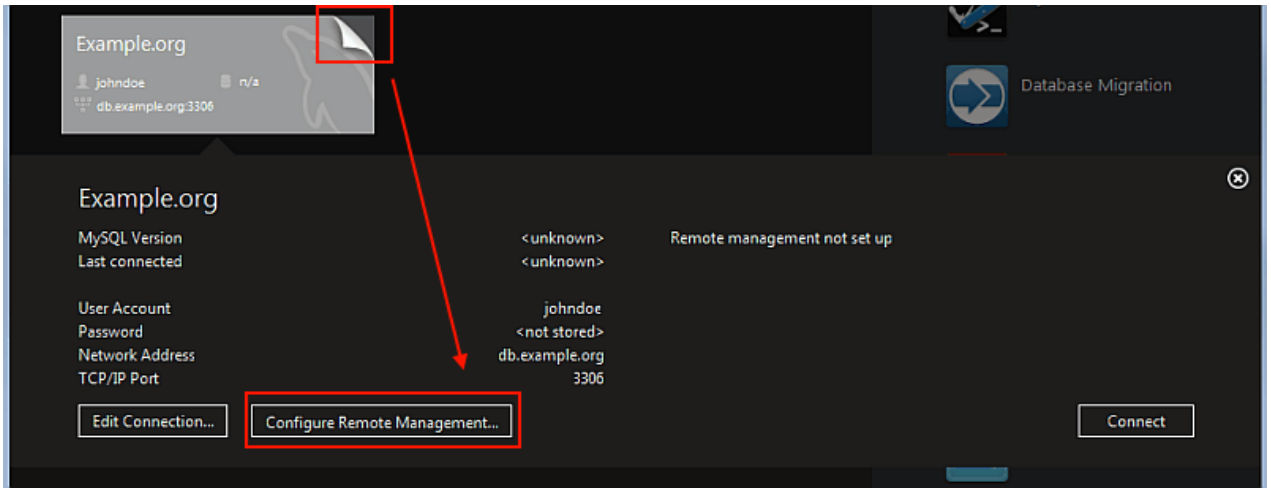
Figure 5.22 Manage Server Connections: Remote Management Tab



5.3.6 Configure Server Management Wizard

Clicking the [+] icon from the Home page launches the **Setup New Connection** wizard. The wizard provides a MySQL connection form to create a new MySQL connection, and includes a Configure Server Management option as a step-by-step approach to creating a new MySQL server connection. This can also be executed later (on remote connections) when from the home page by clicking the top right corner of a MySQL connection tile:

Figure 5.23 Configure Remote Management



Executing this wizard is required to perform tasks requiring shell access to the host. For example, starting/stopping the MySQL instance and editing the configuration file.

For a tutorial that demonstrates the steps outlined below, see the tutorial titled Section 5.2, “Creating A New MySQL Connection (Tutorial)”.

The steps presented in the wizard are as follows:

1. **Test DB Connection**

   On this page, MySQL Workbench tests your database connection and displays the results. If an error occurs, click Show Logs to view the related logs.

2. **Management and OS**

   Used to specify a remote management type and target operating system, which is available when the Host Machine is defined as a remote host.

   The SSH login based management option includes configuration entries for the Operating System and MySQL Installation Type.

3. **SSH Configuration**

   If you specified a Remote Host on the Specify Host Machine page, you will be presented with the Host SSH Connection page, that enables you to use SSH for the connection to the server instance. This facility enables you to create a secure connection to remotely administer and configure the server instance. You must enter the host name and user name of the account that will be used to log in to the server for administration and configuration activities. If you do not enter the optional SSH Key for use with the server, then you will be prompted for the password when the connection is established by MySQL Workbench.

   Note

   This connection is to enable remote administration and configuration of the MySQL Server itself. It is not the same as the connection used to connect to a server for general database manipulation.

   Note

   You must use an SSH connection type when managing a remote server if you wish to start or stop the server or edit its configuration file. Other administrative functions do not require an SSH connection.

4. **Windows Management**

   If a Windows server is used, then setting the Windows configuration parameters is mandatory. Windows management requires a user account with the required privileges to query the system status, and to control services. And read/write access to the configuration file is needed to allow editing of the file.

5. **Test Settings**

   The wizard now attempts a connection to your server and reports the results. If an error occurs, click Show Logs to view the related logs.

   MySQL Workbench must know where the MySQL Server configuration file is located to be able to display configuration information. The wizard is able to determine the most likely location of the

configuration file, based on the selection made on the Operating System page of the wizard. However, it is possible to test that this information is correct by clicking the Check path and Check section buttons. The wizard then reports whether the configuration file and server configuration section can in fact be accessed. It is also possible to manually enter the location of the configuration file, and the section pertaining to MySQL Server data; these manually entered values should be tested using the buttons provided. Click the Next button to continue.

6. **Review Settings**

   The modified settings may be reviewed, which also includes the default values. Check the Change Parameters checkbox if the MySQL Config File section will be edited, and then click Next to continue.

7. **MySQL Config File**

   Allows configuration of the MySQL server version. It also allows the editing and validation of the configuration file path, and validation of the server instance section. Click Next to continue.

8. **Specify Commands**

   Optionally set the commands required to start, stop, and check the status of the running MySQL server instance. Commands can be customized, if required, but the defaults are suitable in most cases. The defaults depend on the selected options on the **Operating System** page of the wizard. Click Next to continue.

9. **Complete Setup**

   Name the MySQL server instance on the final step. This name is used throughout MySQL Workbench as a reference to this MySQL connection. After setting a suitable name, click Finish to save the instance.

5.3.7 The Password Storage Vault

The vault provides a convenient secure storage for passwords used to access MySQL servers. By using the vault, you need not enter credentials every time MySQL Workbench attempts to connect to a server.

Note

The hostname is used for storing password information. For example, a local connection might use "localhost", "127.0.0.1", or "::1", but these are stored separately in the password storage vault, even if they all resolve to the same place.

The vault is implemented differently on each platform:

- **Windows**: The vault is an encrypted file in the MySQL Workbench `data` directory. This is where `connections.xml` and related files are located. The file is encrypted using a Windows API which performs the encryption based on the current user, so only the current user can decrypt it. As a result it is not possible to decrypt the file on any other computer. It is possible to delete the file, in which case all stored passwords are lost, but MySQL Workbench will otherwise perform as expected. You then must re-enter passwords as required.
- **OS X**: The vault is implemented using the OS X Secure Keychain. The keychain contents is also viewable from the native `Keychain Access.app` utility.
- **Linux**: The vault works by storing passwords using the `gnome-keyring` daemon, which must be running for password persistence to work. The daemon is automatically started in GNOME desktops, but normally is not in KDE and others. The `gnome-keyring` daemon stores passwords for MySQL Workbench on non-GNOME platforms, but it must be started manually.

5.4 MySQL Fabric Integration

Browse, view status, and connect to any MySQL instance in a Fabric Cluster.

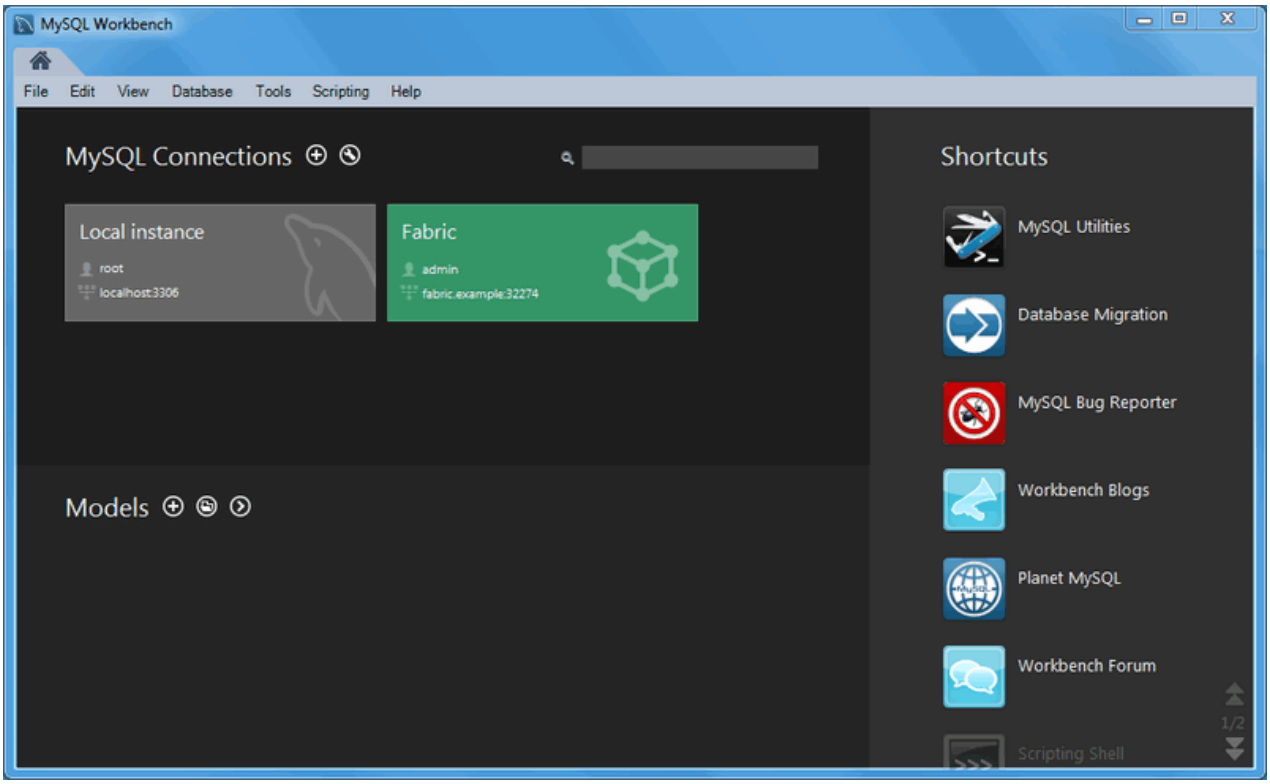
Note

This requires Connector/Python and MySQL Fabric 1.5 and above installed, including the Python module. This feature also requires MySQL Workbench 6.3+.

Fabric 1.5 support was added in MySQL Workbench 6.3, and due to incompatible protocol changes, Fabric 1.4 support was dropped. Also, MySQL Workbench 6.2 added Fabric 1.4 support.

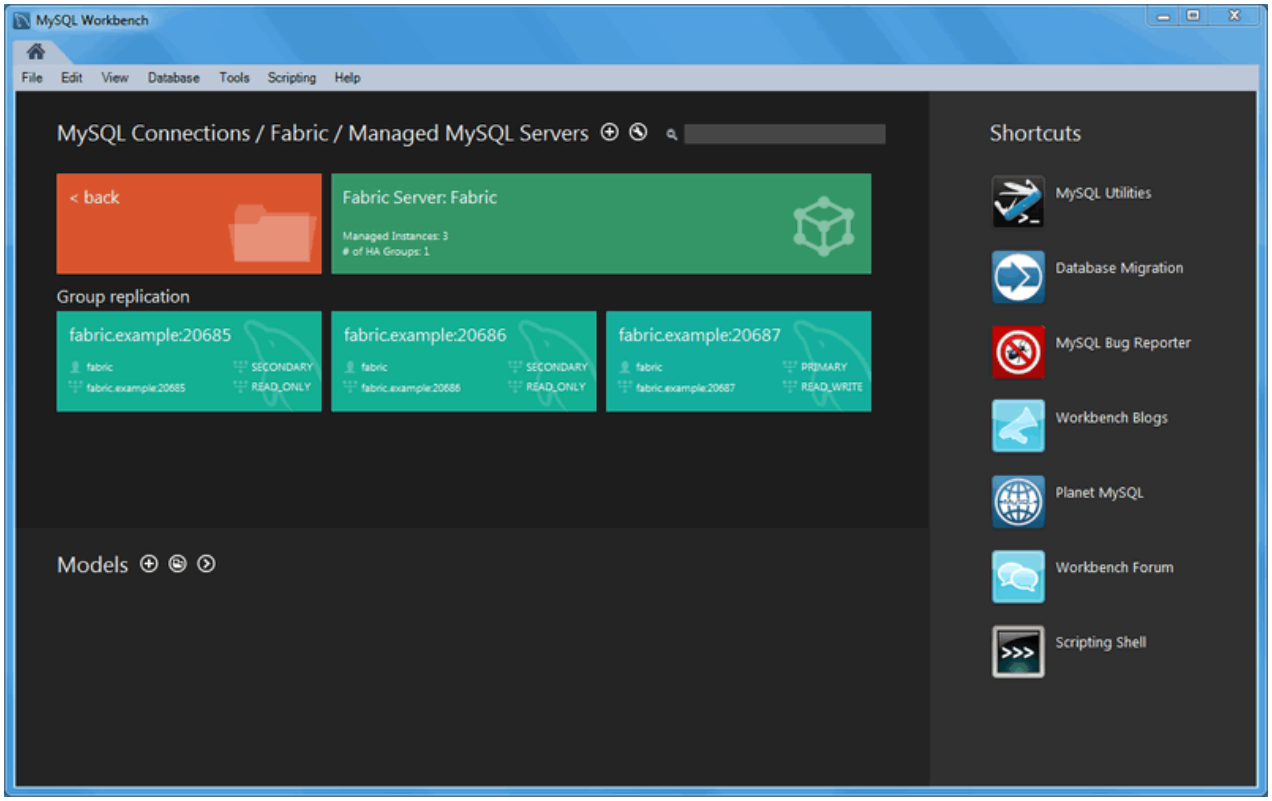
To set up a managed Fabric connection, create a new MySQL connection with the new MySQL Fabric Management Node connection method. The connection tiles have a different look:

Figure 5.24 Fabric Connection Group Tile



Clicking the new fabric group tile shows the managed connections:

Figure 5.25 Fabric Connection Group Tiles



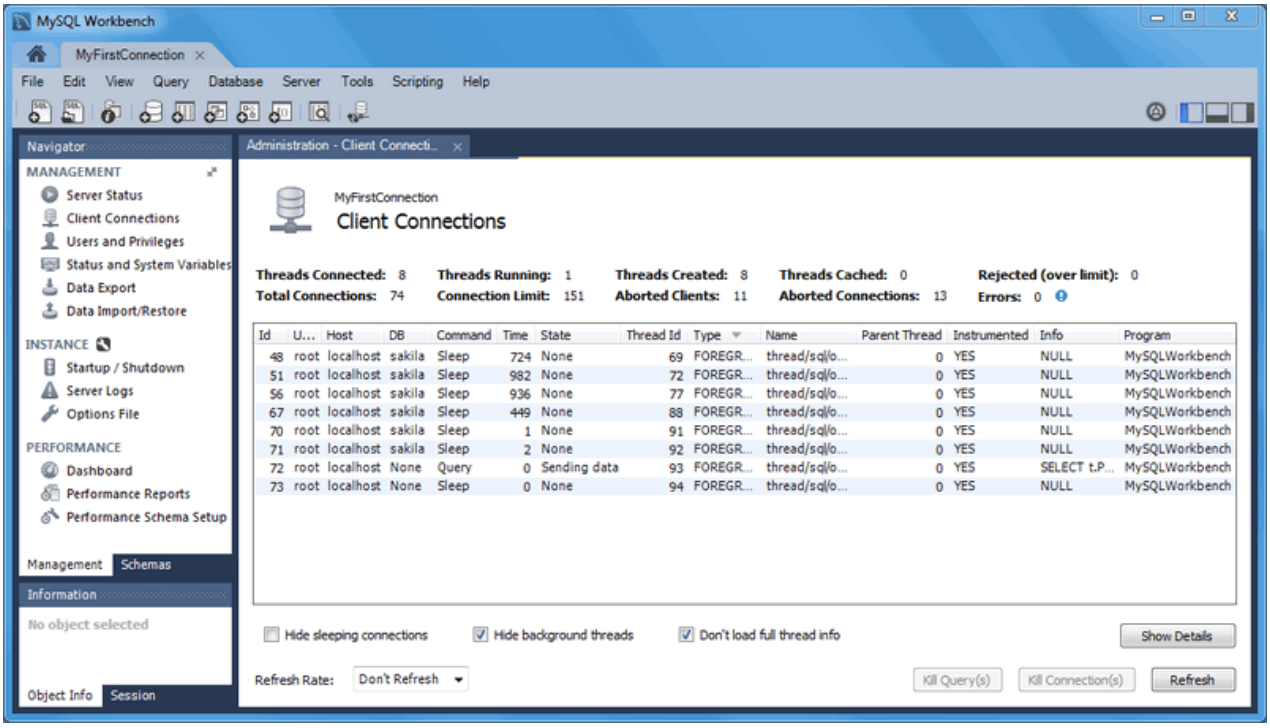
5.5 Client Connections

The client connection browser lists the active and sleeping MySQL client connections, and adds the ability to kill statements and connections, and view additional connection details and attributes.

Note

The connection details viewer requires MySQL 5.6 or greater. Only basic connection information is available for previous versions of MySQL, such as the connection hosts, database, and state.

Figure 5.26 Client Connection Overview

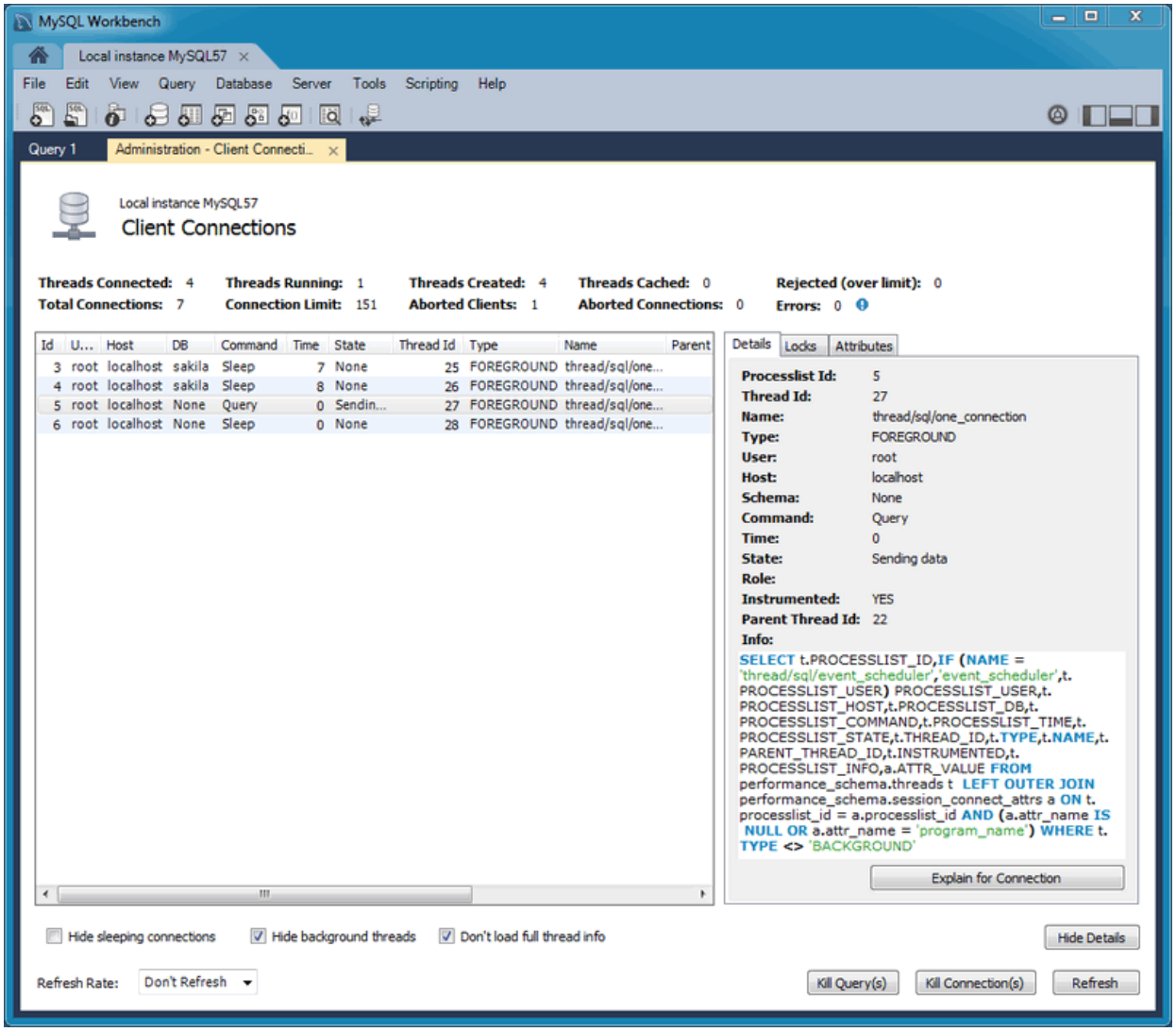

MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
Administration - Client Connecti...
MyFirstConnection
Client Connections
Threads Connected: 8 Threads Running: 1 Threads Created: 8 Threads Cached: 0 Rejected (over limit): 0
Total Connections: 74 Connection Limit: 151 Aborted Clients: 11 Aborted Connections: 13 Errors: 0
Id U... Host DB Command Time State Thread Id Type Name Parent Thread Instrumented Info Program
48 root localhost sakila Sleep 724 None 69 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
51 root localhost sakila Sleep 982 None 72 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
56 root localhost sakila Sleep 936 None 77 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
67 root localhost sakila Sleep 449 None 88 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
70 root localhost sakila Sleep 1 None 91 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
71 root localhost sakila Sleep 2 None 92 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
72 root localhost None Query 0 Sending data 93 FOREGR... thread/sql/o... 0 YES SELECT t.P... MySQLWorkbench
73 root localhost None Sleep 0 None 94 FOREGR... thread/sql/o... 0 YES NULL MySQLWorkbench
Hide sleeping connections
Hide background threads
Don't load full thread info
Show Details
Refresh Rate: Don't Refresh
Kill Query(s)
Kill Connection(s)
Refresh

Client Connections and Metadata locks

The **Client Connections** management window includes a Show Details for connections to MySQL 5.6 and above. These details are separated into three tabs:

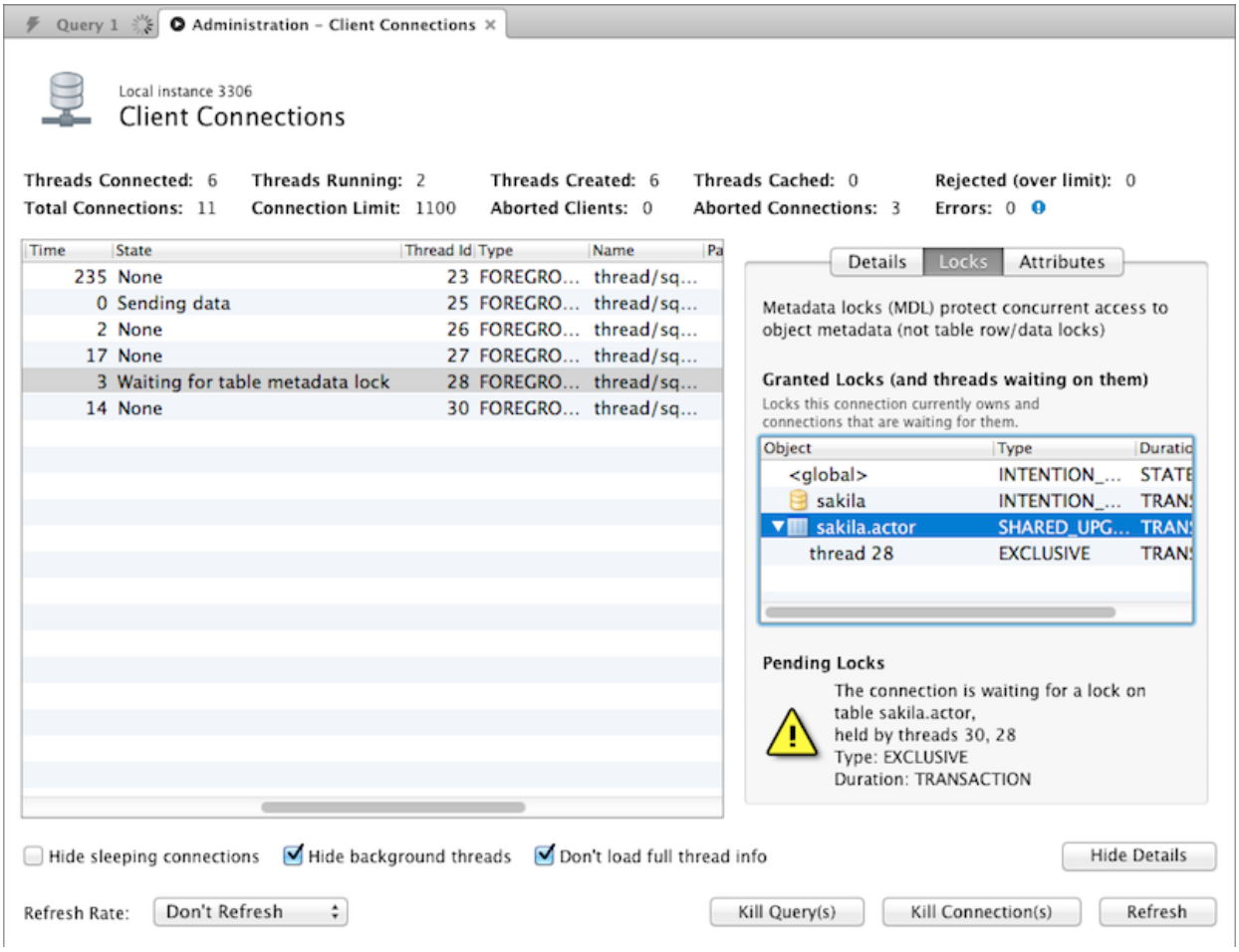
- **Details**: connection details such as Process ID, Type, User, Host, Instrumented, and additional information.

Figure 5.27 Client Connections Details



- **Locks**: MySQL uses metadata locking to manage access to objects such as tables and triggers. Sometimes a query might be blocked while being manipulated by another connection from another user. The **Locks** feature utilizes these MySQL metadata locks (MDL) to show the locked connections that are blocked or being waiting on, and shows information about the locks, what they are waiting for, and what they hold.

Figure 5.28 Metadata Locks Browser

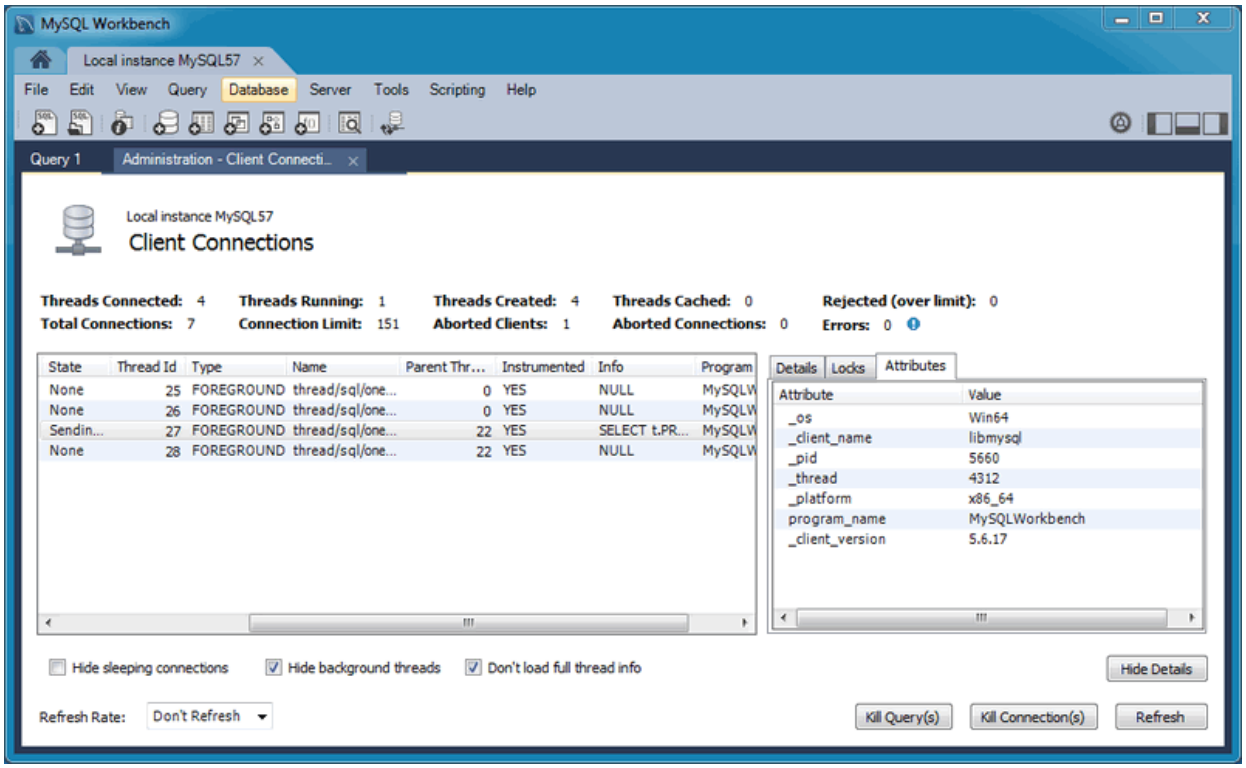


Note

The metadata lock information is provided in the performance schema as of MySQL server 5.7.3.

- **Attributes**: these are connection attributes such as OS, Client Name, Client Version, and Platform.

Figure 5.29 Client Connection Attributes



Chapter 6 Administrative Tasks

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MySQL Workbench provides a visual GUI to administer your MySQL environment. The available visual tools help configure your MySQL servers, administer users, perform backup and recovery, inspect audit data, and view database health.

6.1 Server Management

Manage your MySQL instances with a comprehensive view of your MySQL server connections. The visual tree based navigation provides detailed information about server and status variables, including the number of threads, bytes sent and received by clients, buffer allocations size, and more.

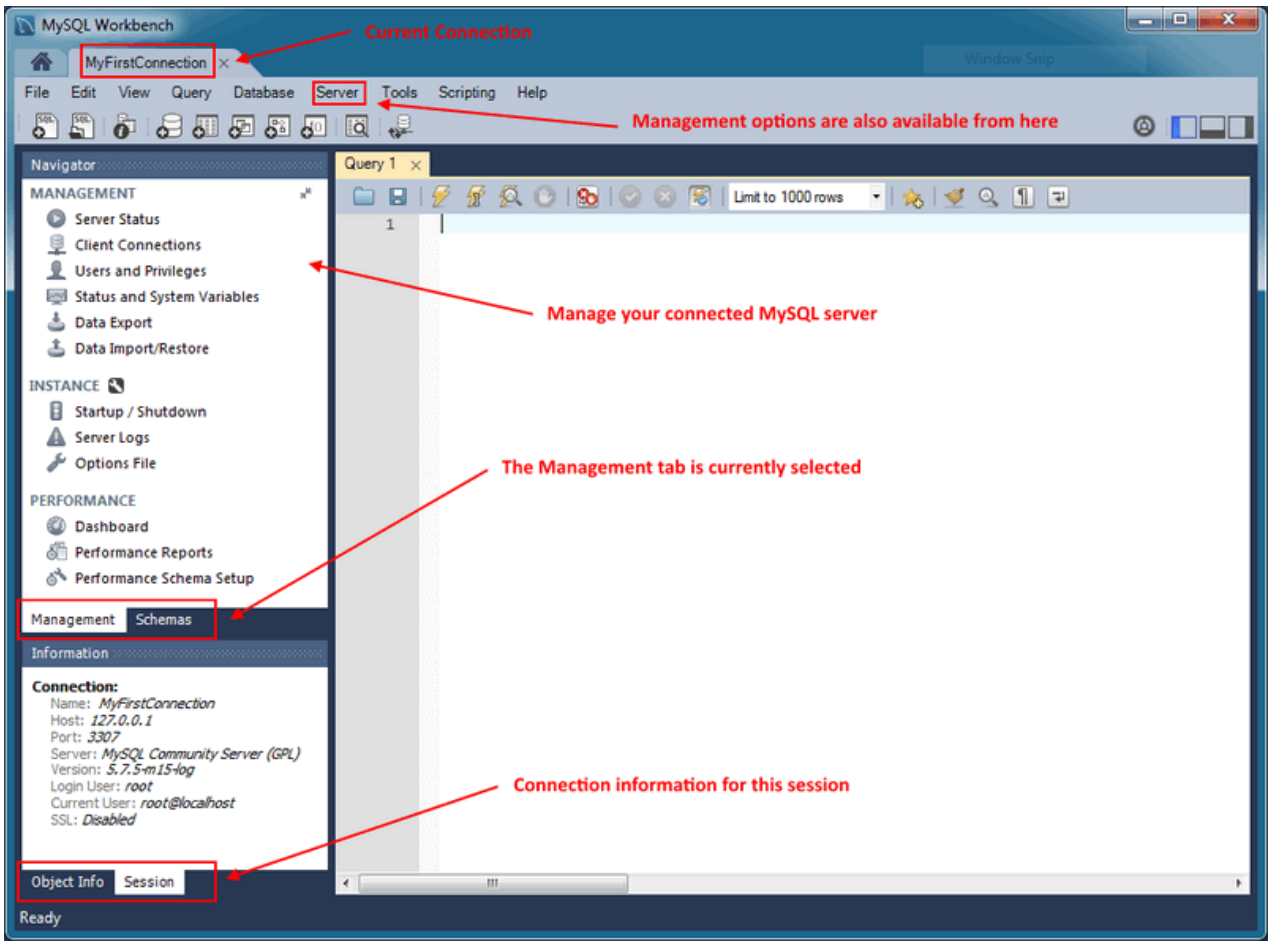
6.1.1 MySQL Connection Navigator

The Navigator panel has a **Management** tab with functionality to monitor and configure your selected MySQL connection.

Note

The Navigator panel also has a **Schemas** tab for managing databases using your MySQL Connection. For information about the Schemas tab, see Section 8.2.1, “Object Browser and Editor Navigator”.

Figure 6.1 SQL Editor - Navigator Management Tab



The Navigator Management tab is separated into the **MANAGEMENT**, **INSTANCE**, and **PERFORMANCE** sections, and the Commercial edition of MySQL Workbench also includes the **MYSQL ENTERPRISE** section.

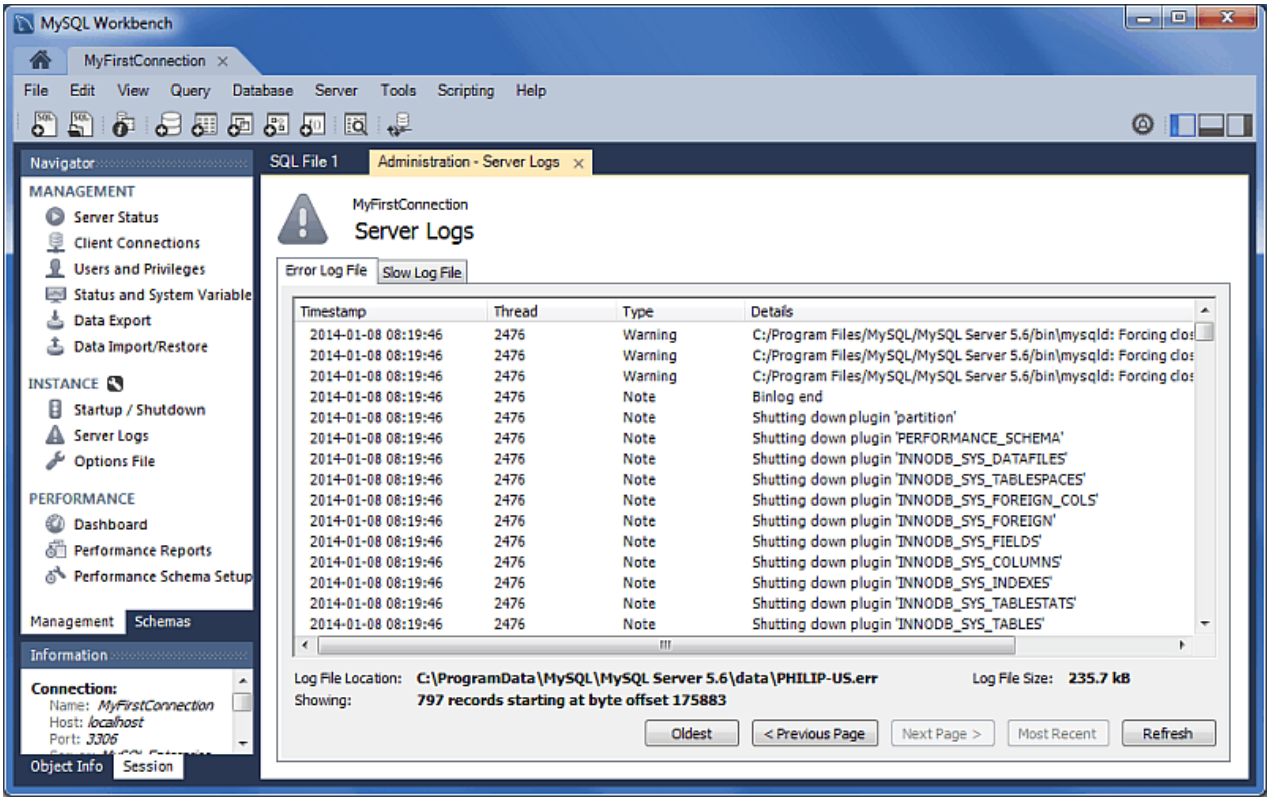
6.1.2 Server Logs

The Server Logs page features two subtabs:

Error Log File

General MySQL errors, for more information see The Error Log

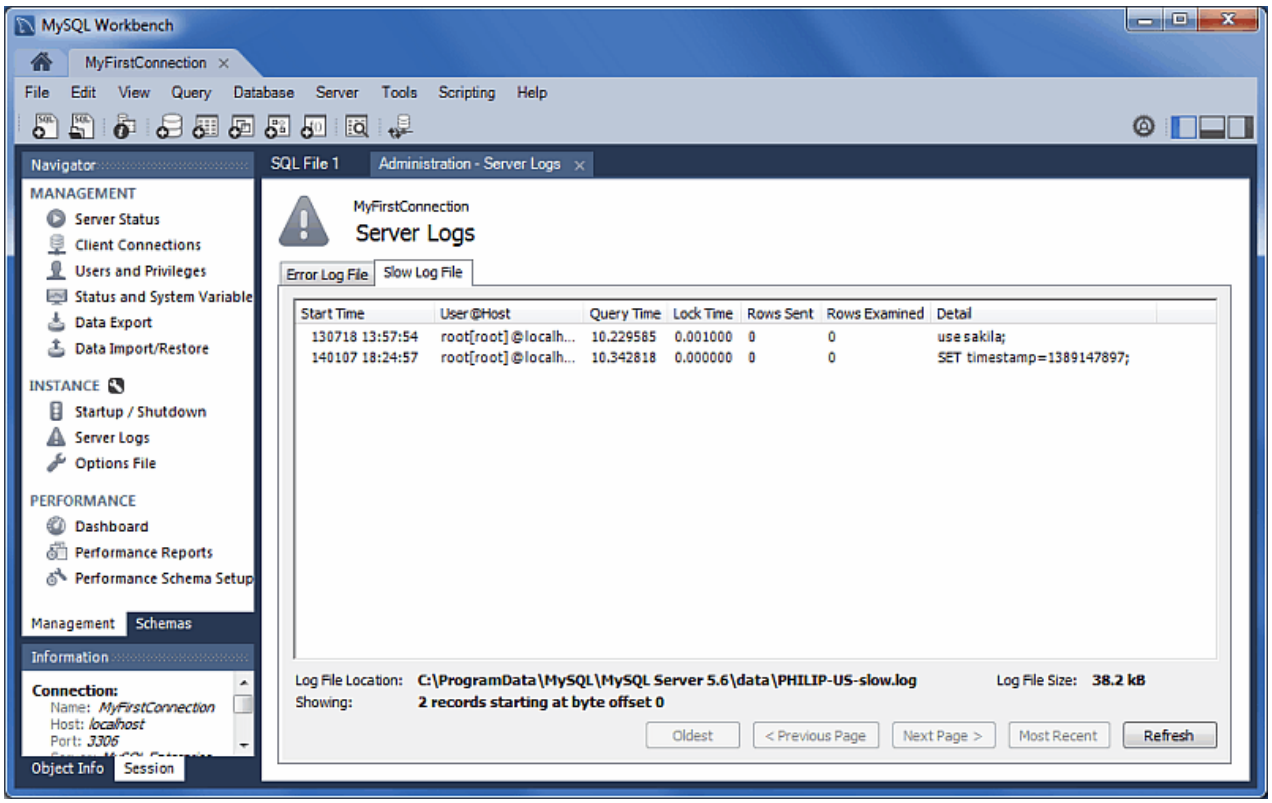
Figure 6.2 Navigator Management: Instance: Server Logs: Error Log


MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variable
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
Connection:
Name: MyFirstConnection
Host: localhost
Port: 3306
Object Info Session
SQL File 1
Administration - Server Logs
MyFirstConnection
Server Logs
Error Log File
Slow Log File
Timestamp Thread Type Details
2014-01-08 08:19:46 2476 Warning C:/Program Files/MySQL/MySQL Server 5.6/bin\mysqld: Forcing clos
2014-01-08 08:19:46 2476 Warning C:/Program Files/MySQL/MySQL Server 5.6/bin\mysqld: Forcing clos
2014-01-08 08:19:46 2476 Warning C:/Program Files/MySQL/MySQL Server 5.6/bin\mysqld: Forcing clos
2014-01-08 08:19:46 2476 Note Binlog end
2014-01-08 08:19:46 2476 Note Shutting down plugin 'partition'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'PERFORMANCE_SCHEMA'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_DATAFILES'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_TABLESPACES'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_FOREIGN_COLS'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_FOREIGN'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_FIELDS'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_COLUMNS'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_INDEXES'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_TABLESTATS'
2014-01-08 08:19:46 2476 Note Shutting down plugin 'INNODB_SYS_TABLES'
Log File Location: C:\ProgramData\MySQL\MySQL Server 5.6\data\PHILIP-US.err
Log File Size: 235.7 kB
Showing: 797 records starting at byte offset 175883
Oldest
< Previous Page
Next Page >
Most Recent
Refresh

Slow Log File

Slow queries (when available), for more information see The Slow Query Log

Figure 6.3 Navigator Management: Instance: Server Logs: Slow Log

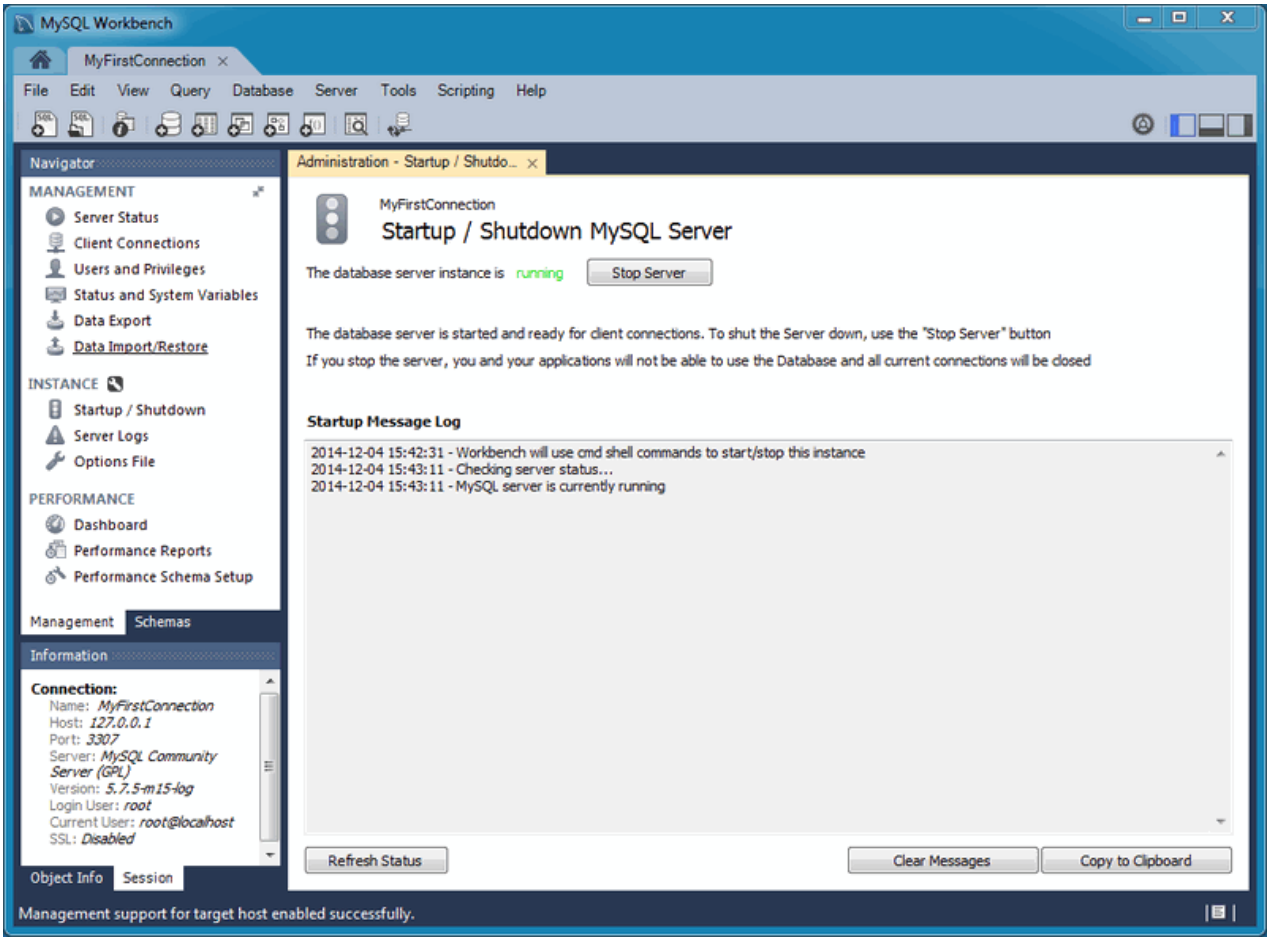


6.1.3 Service Control

The **Startup / Shutdown** functionality includes:

- Viewing the **Startup Message Log**
- Start up and shut down the MySQL instance
- View the current status of the MySQL instance

Figure 6.4 Navigator Management: Instance: Startup / Shutdown



6.1.4 Configuration (options file)

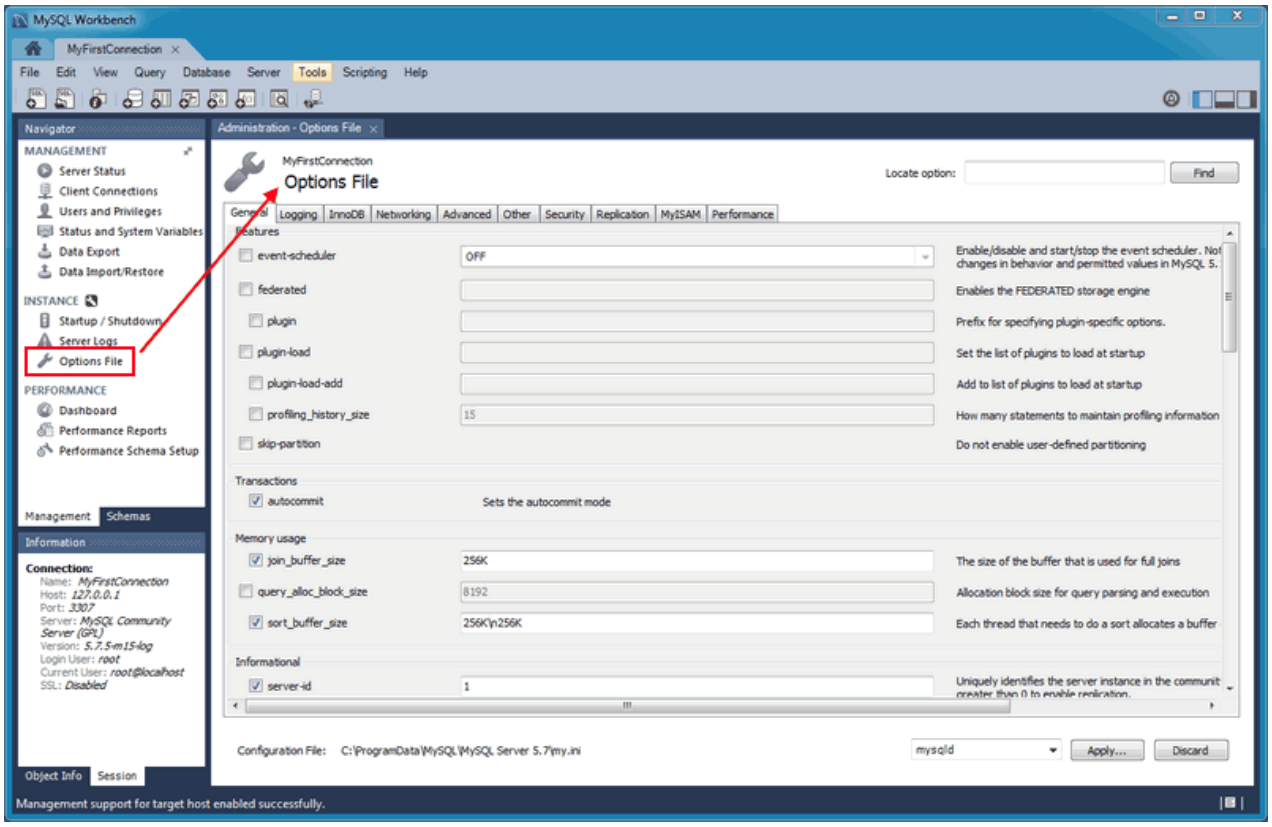
The **Options File** editor is used to view and edit the MySQL configuration file (`my.ini` on Windows, or `my.cnf` on Linux / OS X) by selecting check boxes and other GUI controls, and then making edits. MySQL Workbench divides the options file into its own groupings as a set of tabs (such as General, Logging, InnoDB, and more). Make an edit and click Apply to commit the changes.

The options file editor includes the following components:

- Option file groupings, as divided into convenient tabs by MySQL Workbench
- A **Locate option** search field to search your MySQL options configuration file
- **Configuration File** path, so you know the configuration file you are editing
- An options file group selector, to select the option [group] to edit. Because the same option can be defined under multiple groupings, it is important to choose the correct group when making edits. `[mysqld]` (the MySQL server) is the default and most common group. For additional information about groups, see Using Option Files.

A screenshot with the General tab selected:

Figure 6.5 Navigator Management: Instance: Options File: General



6.2 Users and Privileges

A listing of all users and privileges that relate to the MySQL connection. You may also manage (add) user accounts, adjust privileges, and expire passwords.

The **Users and Privileges** page has several sections:

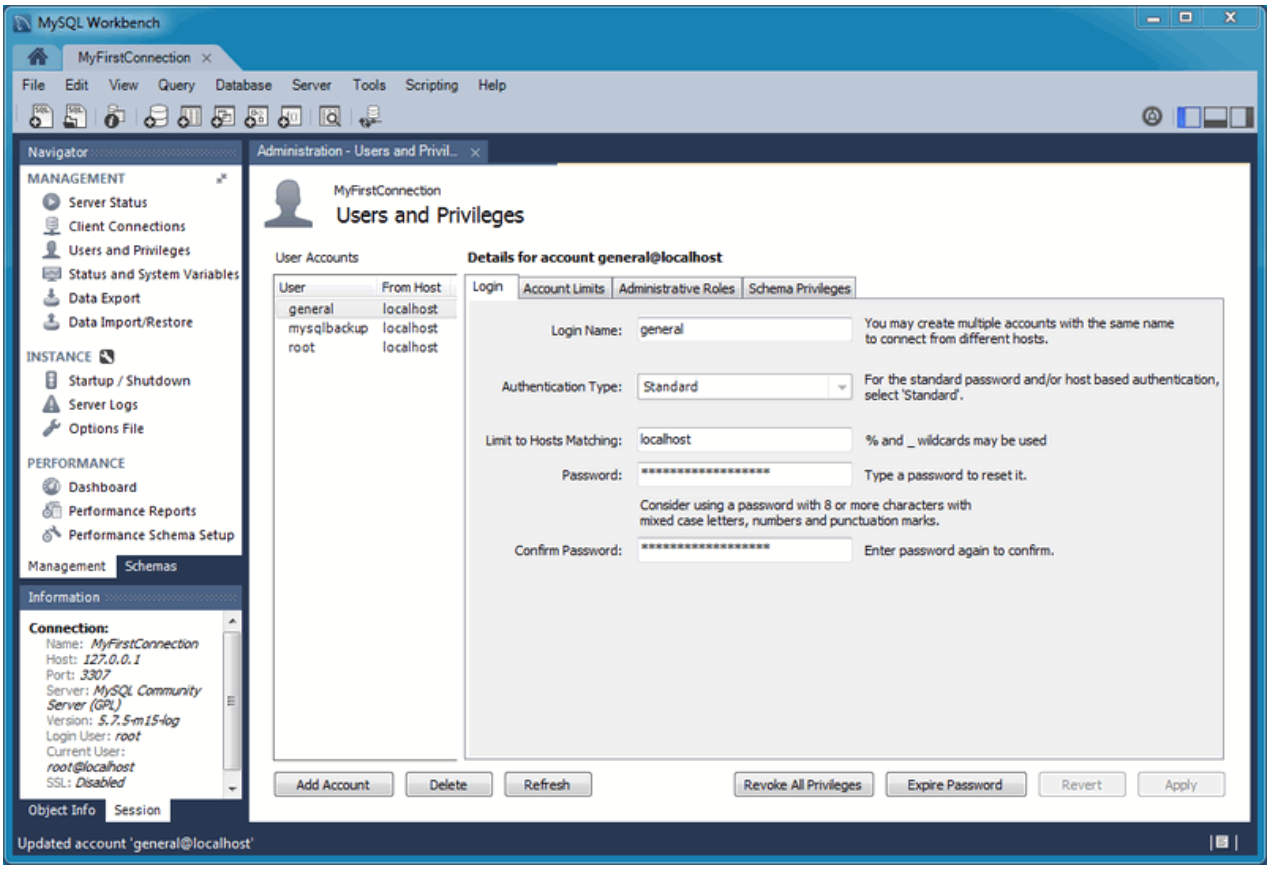
User Accounts

Lists each user account that is associated to the active MySQL connection.

Login

Login information related to the selected user account.

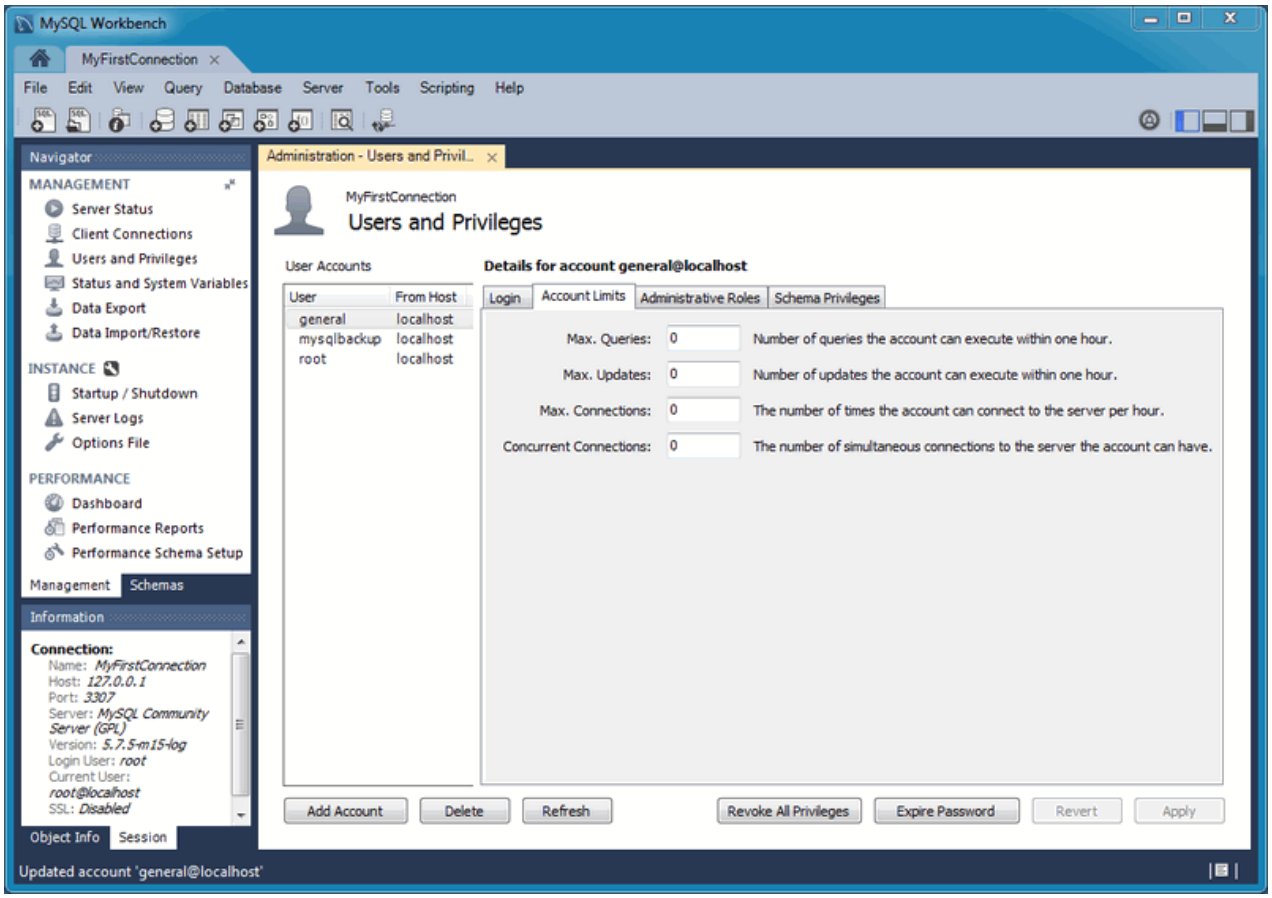
Figure 6.6 Navigator Management: User And Privileges: Login



Account Limits

Define limits for the user account, such as the maximum number of queries, updates, connections, and concurrent connections that an account can execute in one hour.

Figure 6.7 Navigator Management: User And Privileges: Account Limits



Administrative Roles

To aid in assigning privileges to MySQL Server users, MySQL Workbench introduces the concept of Administrative Roles. Roles are a quick way of granting a set of privileges to a user, based on the work the user must carry out on the server. It is also possible to assign multiple roles to a user. To assign roles, click the User Account you wish to modify, then click the **Administrative Roles** tab. Then click the check boxes according to the roles you wish to allocate to the user. After you select a role to a user, you will see the accumulated privileges in the **Global Privileges Assigned to User** panel. For example, if you select the role `BackupAdmin`, the privileges granted include `EVENT`, `LOCK TABLES`, `SELECT`, `SHOW DATABASES`. If you also select the role of `ReplicationAdmin`, the list of privileges expands to include `REPLICATION CLIENT`, `REPLICATION SLAVE` and `SUPER`.

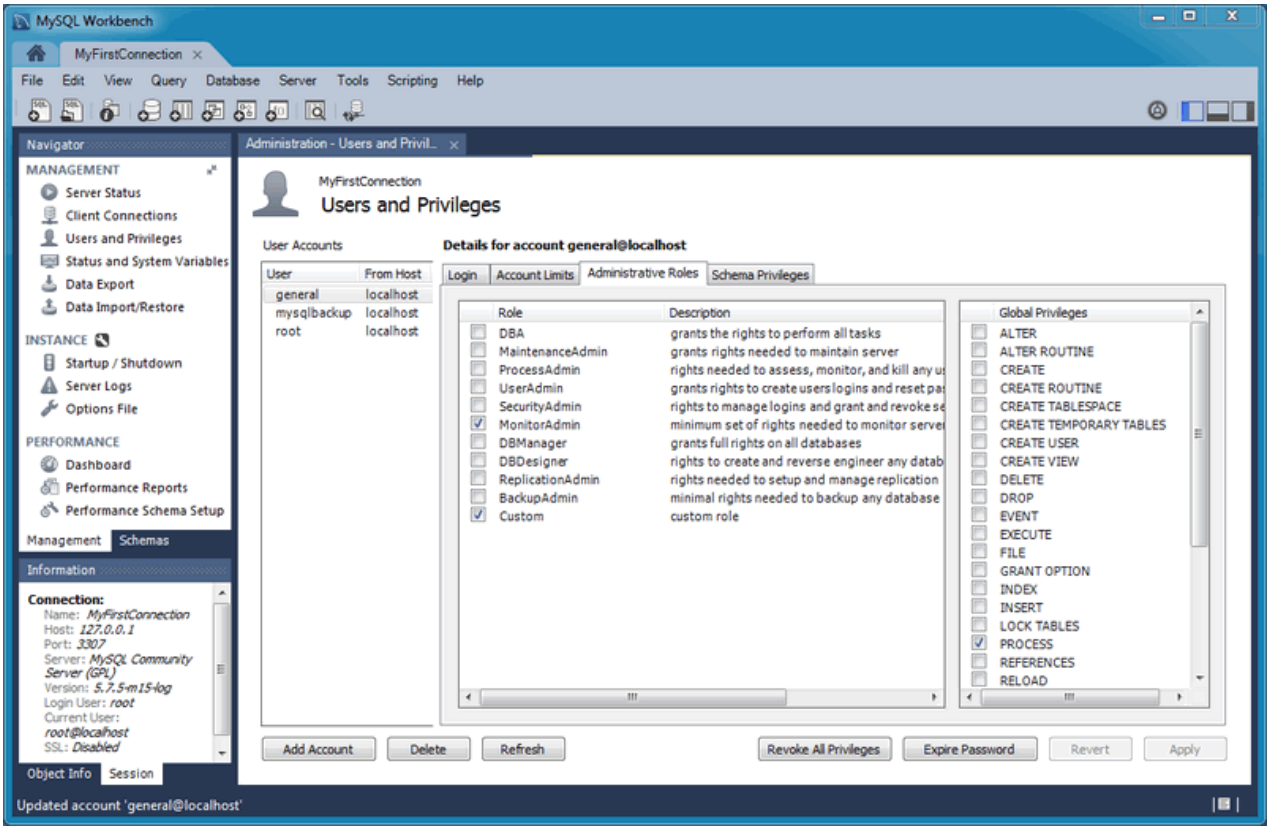
These roles are available:

- **DBA**: Grants all privileges
- **MaintenanceAdmin**: Grants privileges to maintain the server
- **ProcessAdmin**: Grants privileges to monitor and kill user processes
- **UserAdmin**: Grants privileges to create users and reset passwords
- **SecurityAdmin**: Grants privileges to manage logins and grant and revoke server privileges
- **MonitorAdmin**: Grants privileges to monitor the server

- **DBManager**: Grants privileges to manage databases
- **DBDesigner**: Grants privileges to create and reverse engineer any database schema
- **ReplicationAdmin**: Grants privileges to set up and manage replication
- **BackupAdmin**: Grants privileges required to back up databases
- **Custom**: Lists other (custom) privileges that are assigned to the user account

The *Password Validation Plugin* (available as of MySQL Server 5.6.6) is supported in Workbench. For information about what these settings mean, see The Password Validation Plugin.

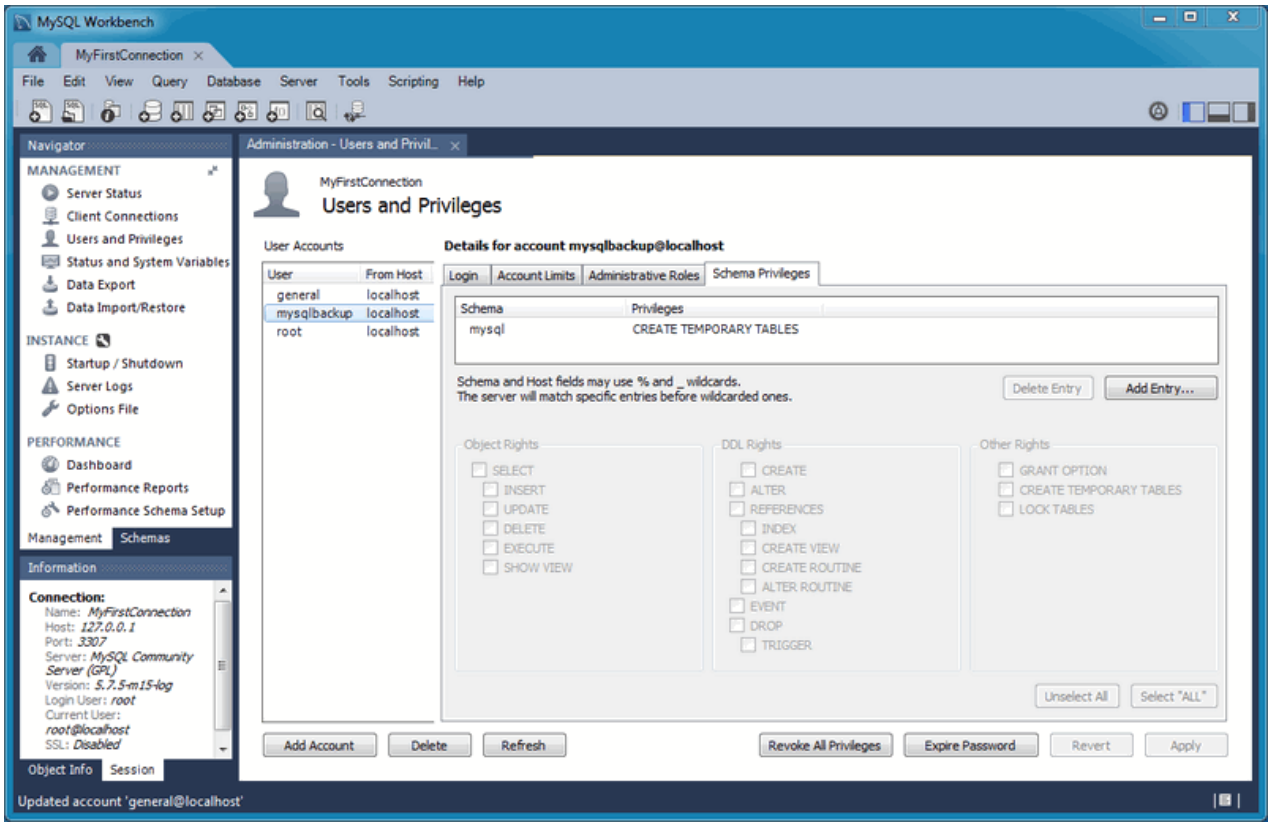
Figure 6.8 Navigator Management: User And Privileges: Administrative Roles



Schema Privileges

Additional schema privileges that the account can use. For example, the standard `mysqlbackup` user has "CREATE TEMPORARY TABLES" on the `mysql` schema.

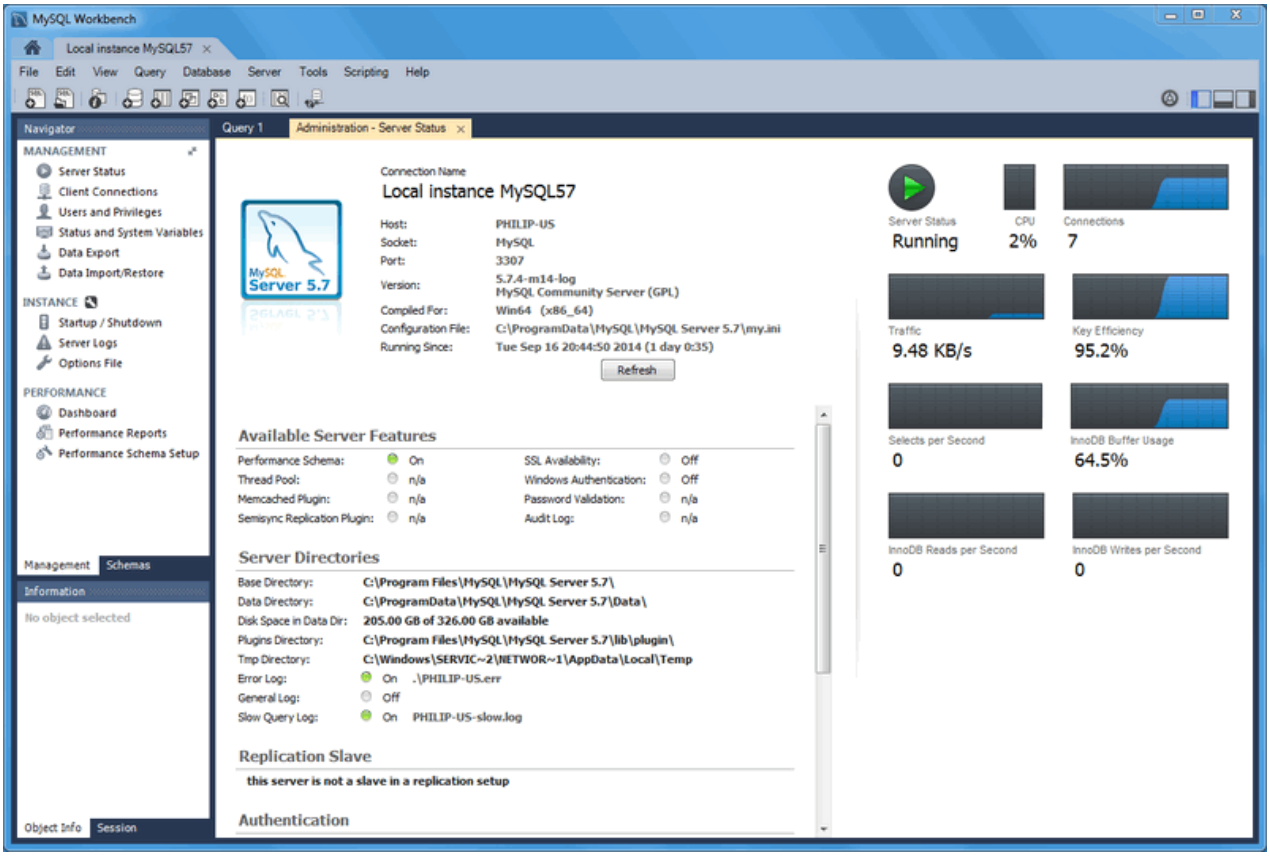
Figure 6.9 Navigator Management: User And Privileges: Schema Privileges



6.3 Server Status

Get an immediate view into the basic health indicators and counters for your MySQL environment. This includes viewing the server's running state (stopped/running), available features, primary server directories, replication state, and security settings for authentication and SSL. Reports also include information and graphs to track memory usage, connections, hit rates, and more.

Figure 6.10 Navigator Management: Server Status



6.4 Status and System Variables

Status and System Variables: Lists all server variables for the MySQL connection. You may also copy all or selected variables to your clipboard.

Figure 6.11 Navigator Management: Status Variables

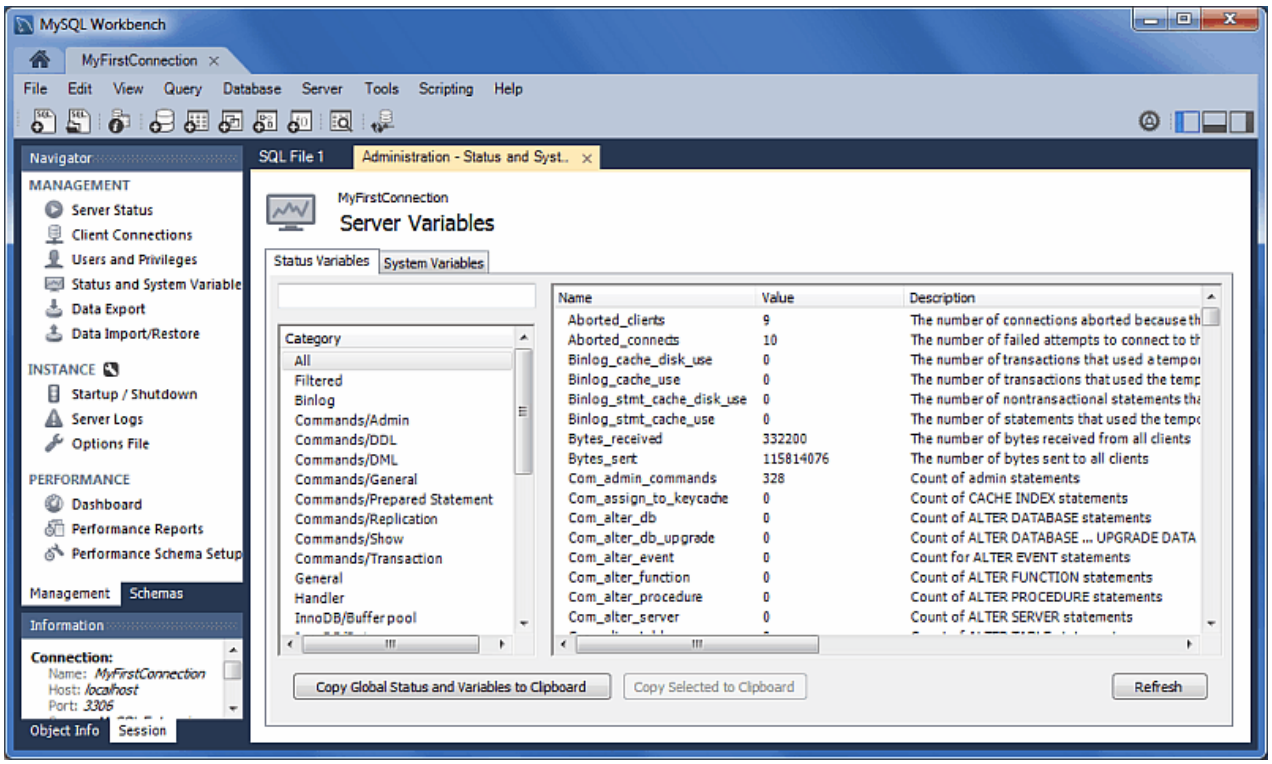
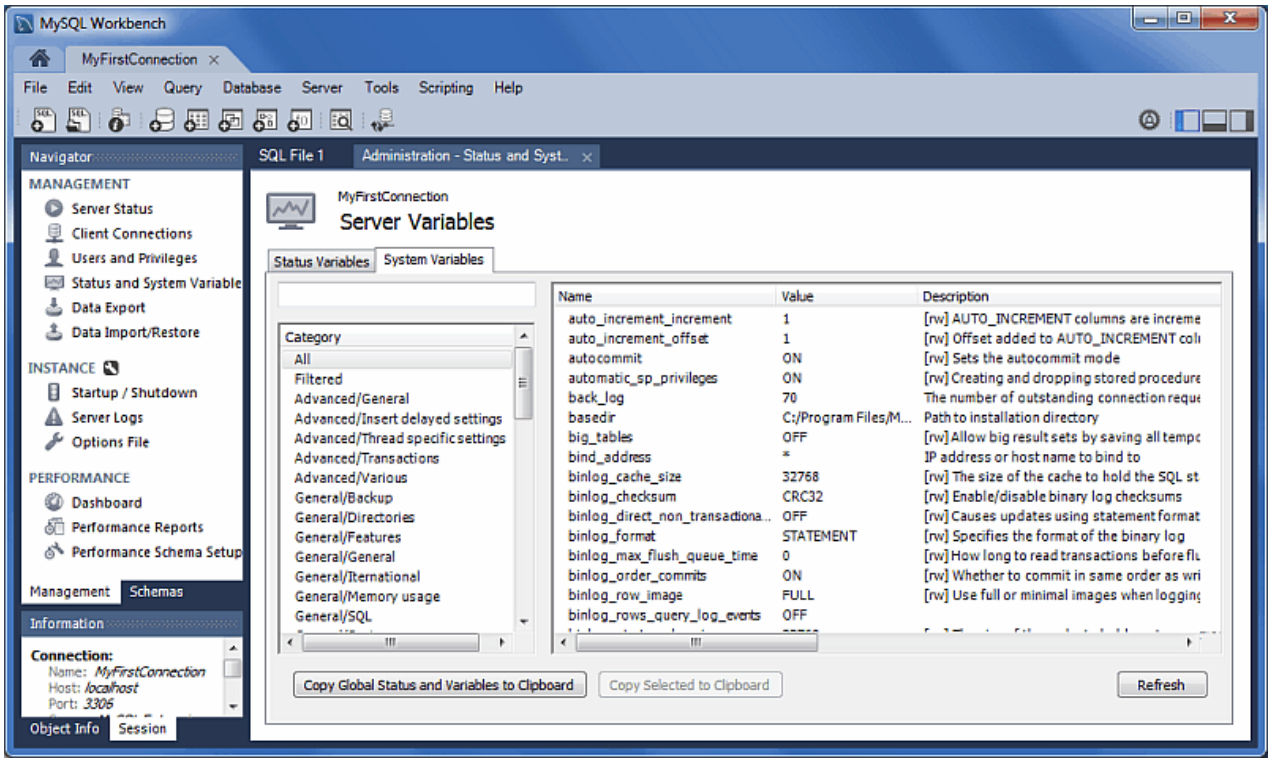


Figure 6.12 Navigator Management: Status Variables

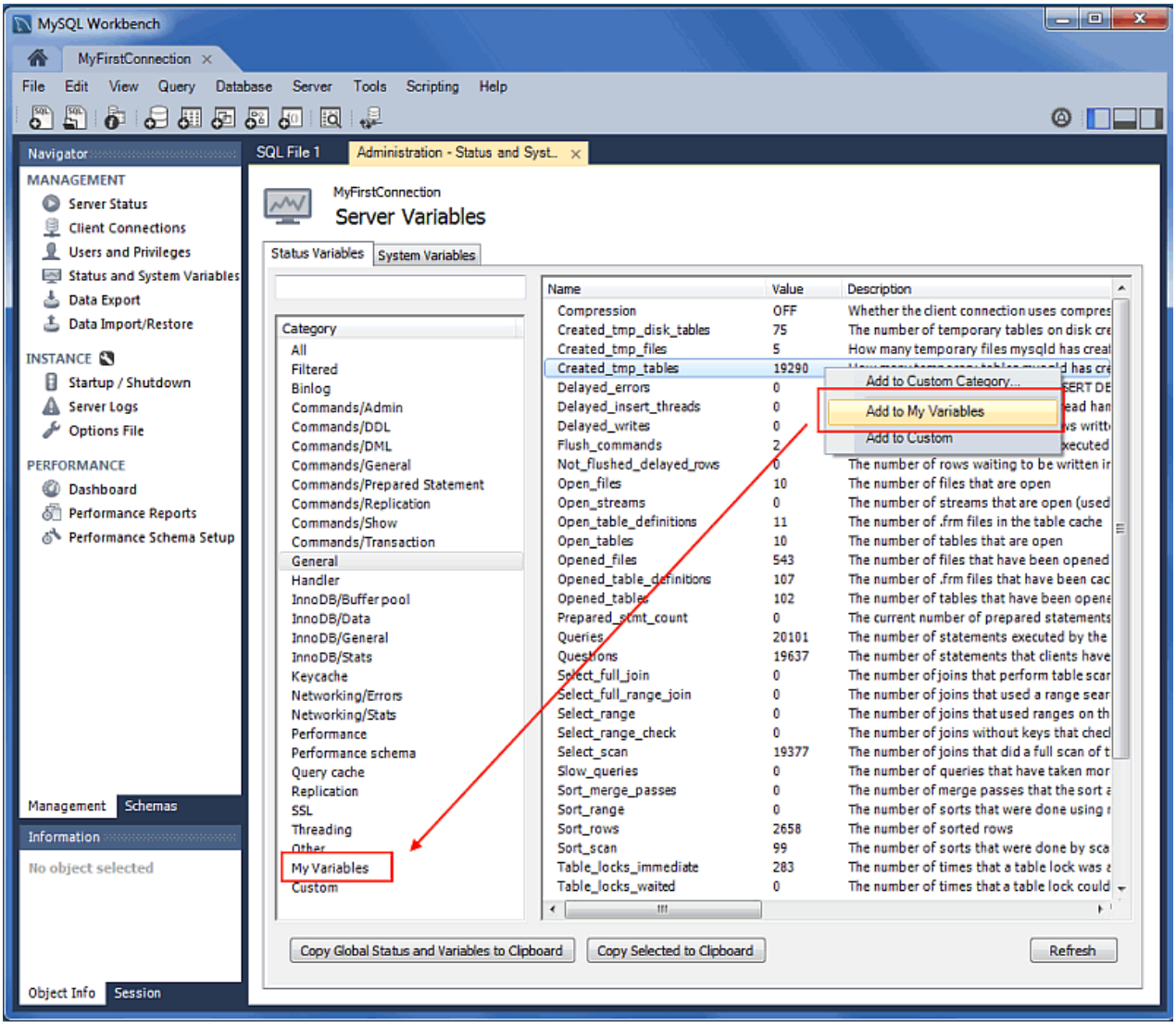


Custom Variable Grouping

The status and system variables are each categorized by groups (such as InnoDB or Logging), and you may also create your own custom groups. Right-click on a variable, choose the custom group (or create a new one), and add the variable to the aforementioned group. Your custom groups are listed along with the pre-existing groups.

In the example below, we created a custom group titled "My Variables" and are in the process of adding the `Created_tmp_variables` variable to it.

Figure 6.13 Navigator Management: Adding A Variable To A Custom Group


MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
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Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
SQL File 1
Administration - Status and Syst...
MyFirstConnection
Server Variables
Status Variables
System Variables
Category
All
Filtered
Binlog
Commands/Admin
Commands/DDL
Commands/DML
Commands/General
Commands/Prepared Statement
Commands/Replication
Commands/Show
Commands/Transaction
General
Handler
InnoDB/Buffer pool
InnoDB/Data
InnoDB/General
InnoDB/Stats
Keycache
Networking/Errors
Networking/Stats
Performance
Performance schema
Query cache
Replication
SSL
Threading
Other
My Variables
Custom
Name
Value
Description
Compression OFF Whether the client connection uses compres
Created_tmp_disk_tables 75 The number of temporary tables on disk cre
Created_tmp_files 5 How many temporary files mysqld has creat
Created_tmp_tables 19290
Delayed_errors 0
Delayed_insert_threads 0
Delayed_writes 0
Flush_commands 2
Not_flushed_delayed_rows 0 The number of rows waiting to be written in
Open_files 10 The number of files that are open
Open_streams 0 The number of streams that are open (used
Open_table_definitions 11 The number of .frm files in the table cache
Open_tables 10 The number of tables that are open
Opened_files 543 The number of files that have been opened
Opened_table_definitions 107 The number of .frm files that have been cac
Opened_tables 102 The number of tables that have been opene
Prepared_stmt_count 0 The current number of prepared statements
Queries 20101 The number of statements executed by the
Questions 19637 The number of statements that clients have
Select_full_join 0 The number of joins that perform table scar
Select_full_range_join 0 The number of joins that used a range sear
Select_range 0 The number of joins that used ranges on th
Select_range_check 0 The number of joins without keys that chec
Select_scan 19377 The number of joins that did a full scan of t
Slow_queries 0 The number of queries that have taken mor
Sort_merge_passes 0 The number of merge passes that the sort a
Sort_range 0 The number of sorts that were done using r
Sort_rows 2658 The number of sorted rows
Sort_scan 99 The number of sorts that were done by sca
Table_locks_immediate 283 The number of times that a table lock was a
Table_locks_waited 0 The number of times that a table lock could
Add to Custom Category...
Add to My Variables
Add to Custom
Copy Global Status and Variables to Clipboard
Copy Selected to Clipboard
Refresh

6.5 Data Export and Import

There are three ways to export and import data in MySQL Workbench, each serving a different purpose.

Table 6.1 Methods to Export or Import data in MySQL Workbench

GUI Location	Data Set	Export Types	Import Types	Additional Details
Object Browser context menu	Tables	JSON, CSV	JSON, CSV	Simple table operations, includes moderate control over the output type (this method was added in version 6.3.0)
Result Grid menu under the SQL editor	Result set (after performing an SQL query)	CSV, HTML, JSON, SQL, XML, Excel XML, TXT	CSV	Simple data operations, includes little control
Management Navigator	Databases and/or Tables	SQL	SQL	Detailed database and table operations, standard backup/restore behavior using the `mysqldump` command and meta data, includes control over how data is handled, and includes meta data
Management Navigator	Databases and/or Tables	SQL	SQL	Detailed database and table operations, includes control over how data is handled, can be scheduled and incremental, includes meta data, uses MySQL Enterprise Backup (commercial)

6.5.1 Table Data Export and Import Wizard

This wizard supports import and export operations using CSV and JSON files, and includes several configuration options (separators, column selection, encoding selection, and more). The wizard can be performed against local or remotely connected MySQL servers, and the import action includes table, column, and type mapping.

Note

This wizard only exports/imports tables using the JSON or CSV format. For an overview of the data export and import options in MySQL Workbench, see Section 6.5, “Data Export and Import”.

The wizard is accessible from the object browser's context menu by right-clicking on a table and choose either Table Data Export Wizard or Table Data Import Wizard.

Figure 6.14 Table Data Wizards: Open

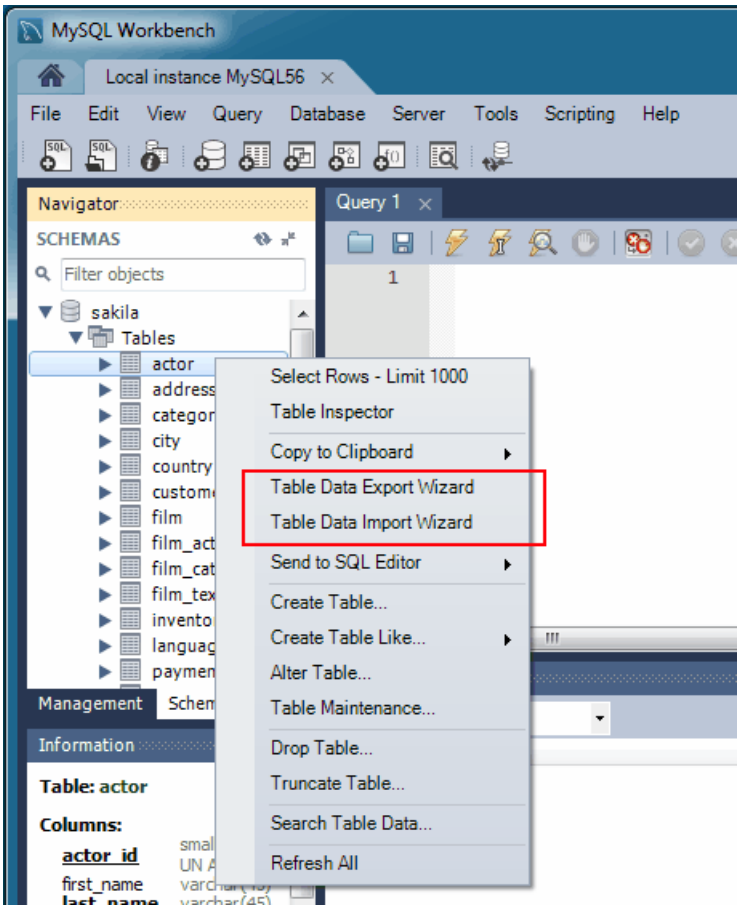


Table Data Export Wizard

Export table data to either a JSON or CSV file. The following example exports the *sakila.actor* table to a CSV file.

Figure 6.15 Table Data Export: Source

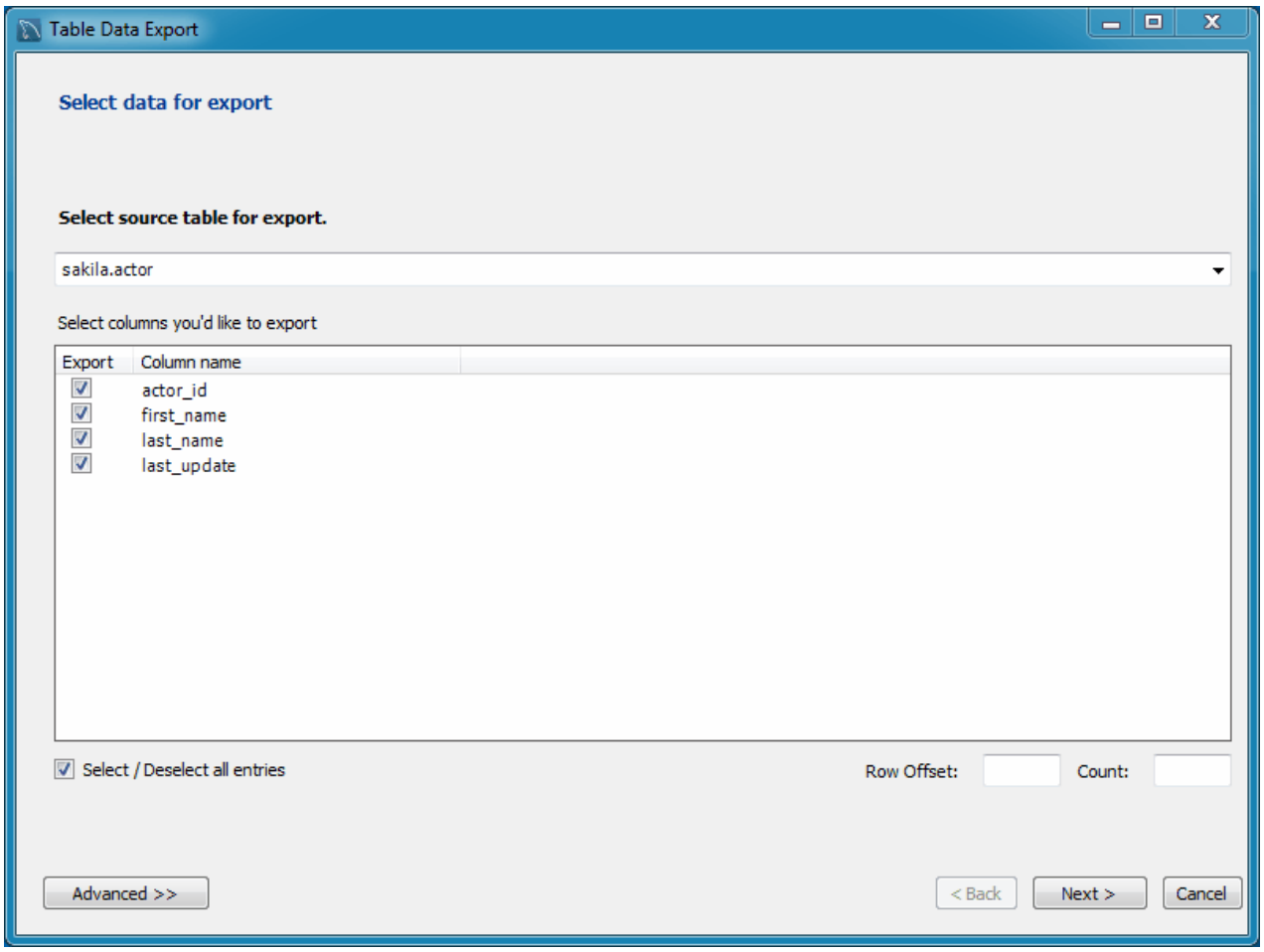


Figure 6.16 Table Data Export: CSV Configuration

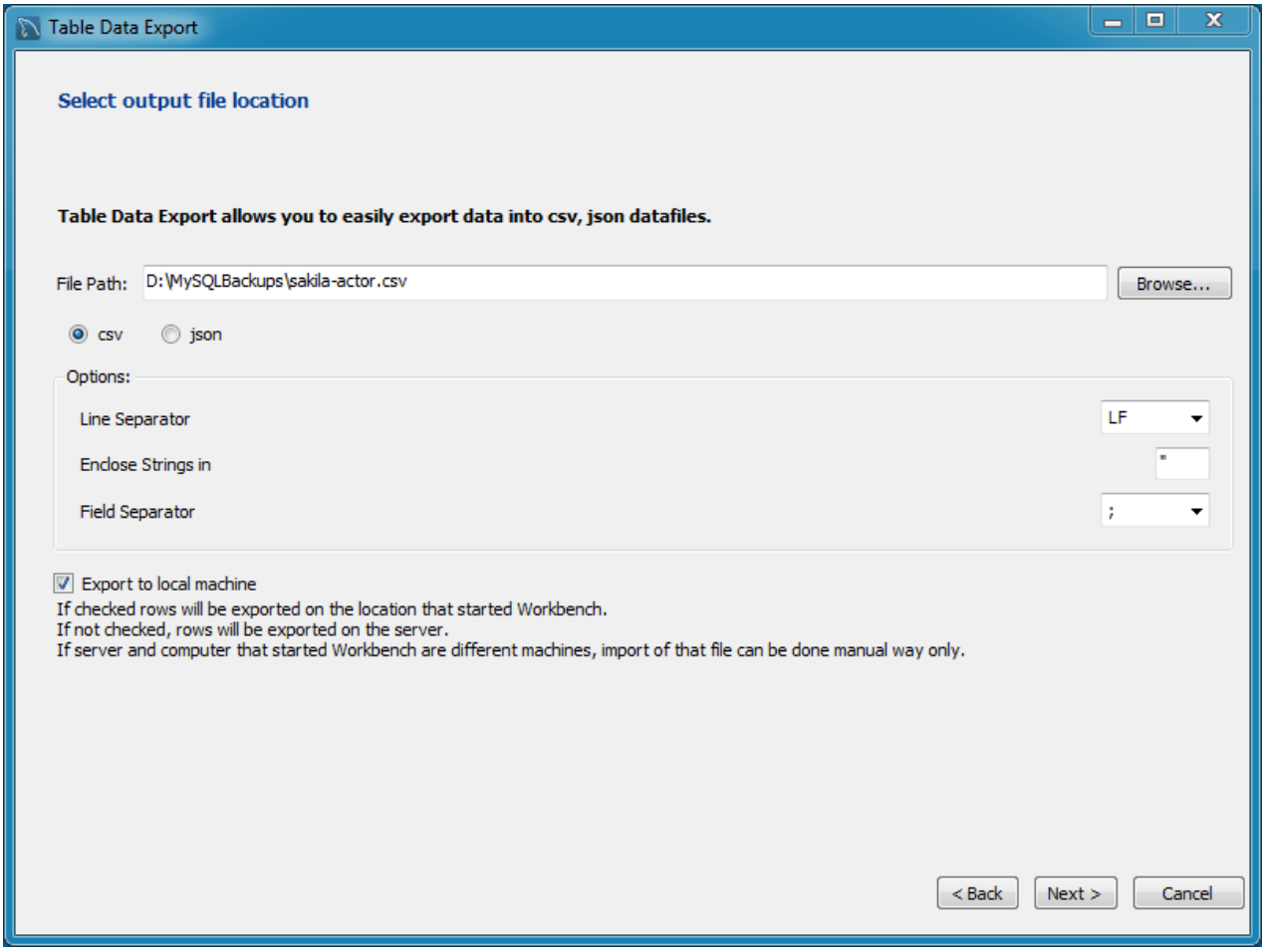


Table Data Export
Select output file location
Table Data Export allows you to easily export data into csv, json datafiles.
File Path:
D:\MySQLBackups\sakila-actor.csv
Browse...
csv
json
Options:
Line Separator
LF
Enclose Strings in
"
Field Separator
;
Export to local machine
If checked rows will be exported on the location that started Workbench.
If not checked, rows will be exported on the server.
If server and computer that started Workbench are different machines, import of that file can be done manual way only.
< Back
Next >
Cancel

Figure 6.17 Table Data Export: Results

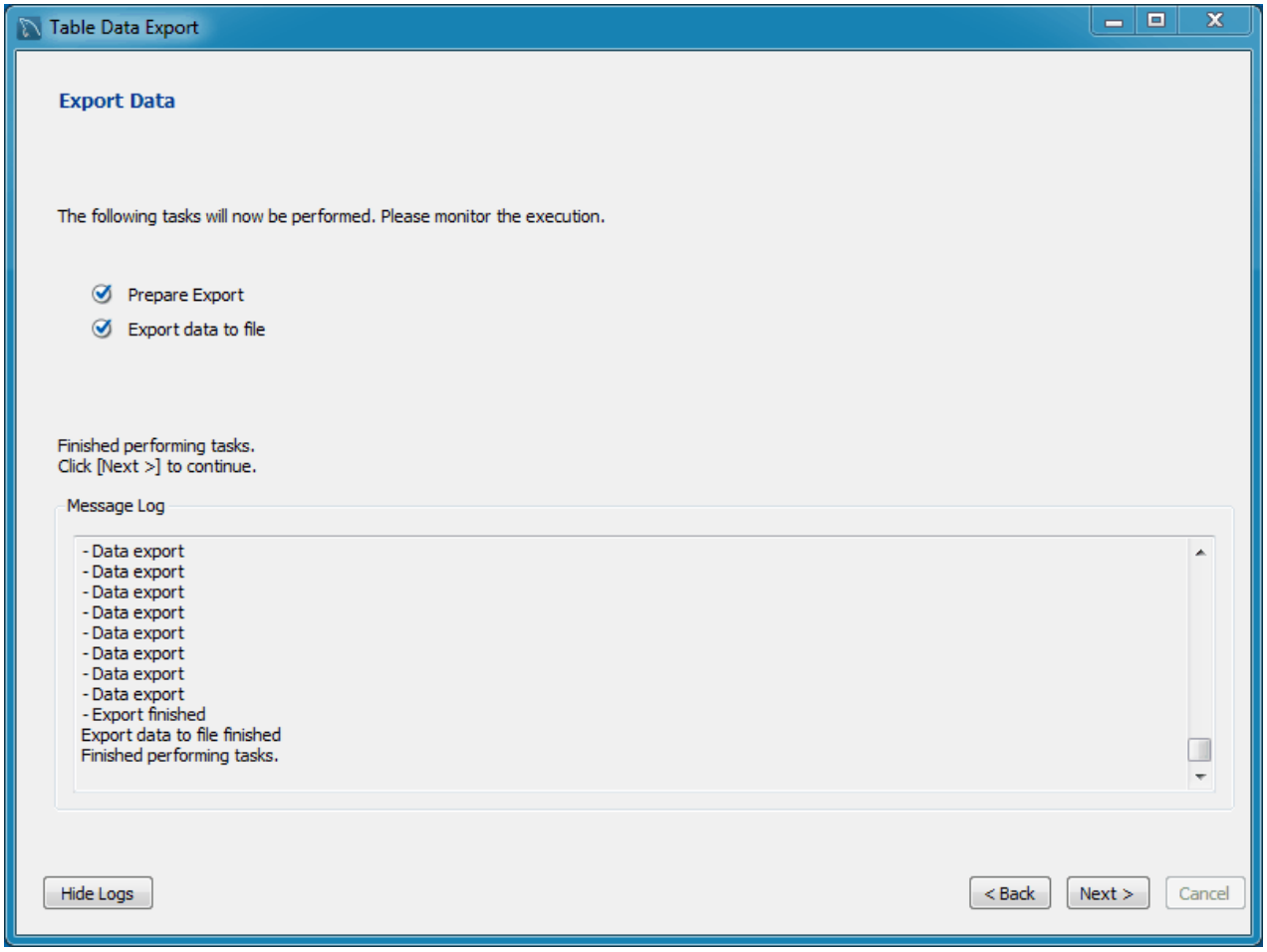


Table Data Import Wizard

Import table data from either a JSON or CSV file. The following example imports the *sakila.actor* table from a CSV file.

Figure 6.18 Table Data Import: CSV Source

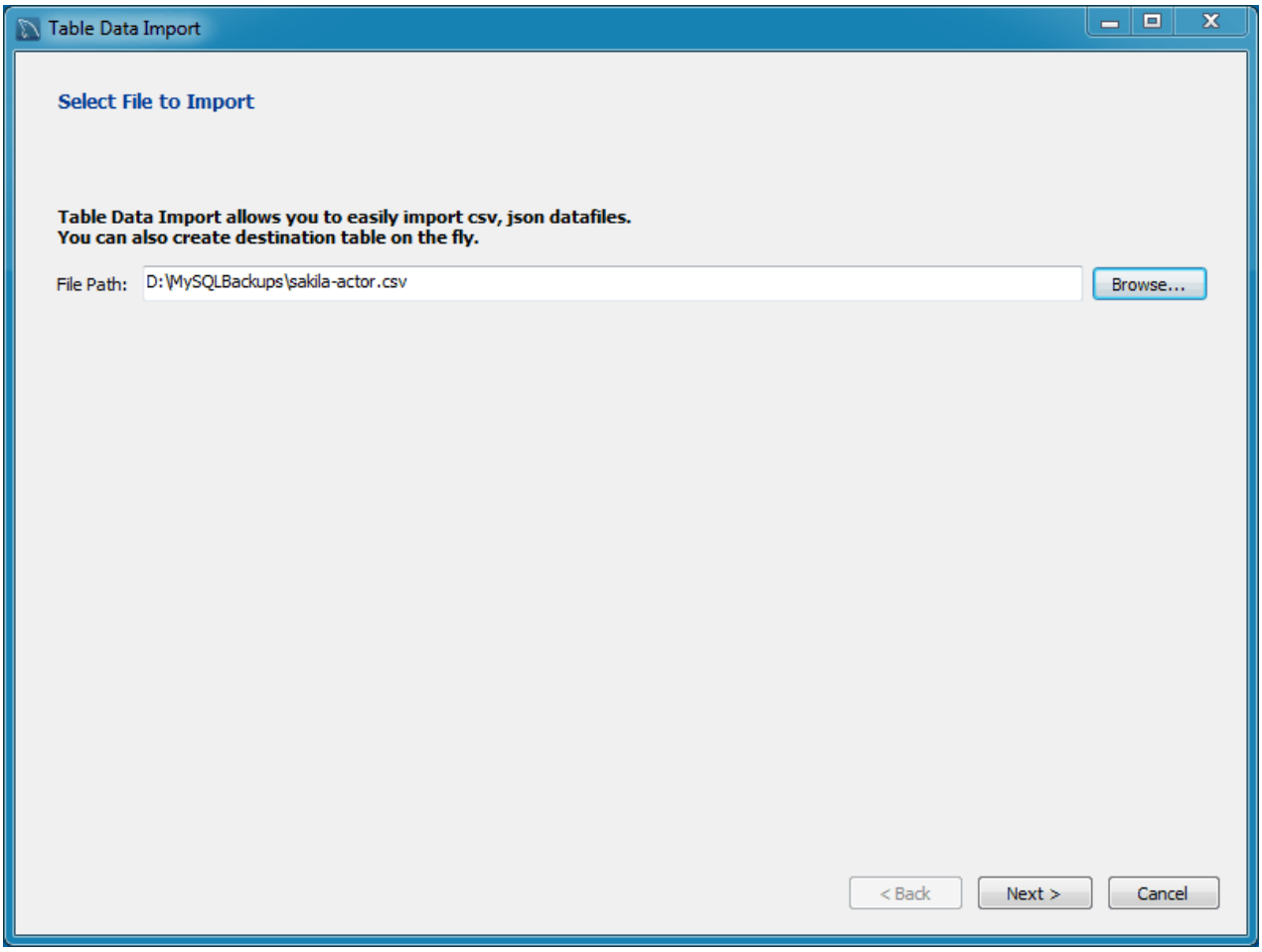


Table Data Import
Select File to Import
Table Data Import allows you to easily import csv, json datafiles.
You can also create destination table on the fly.
File Path:
D:\MySQLBackups\sakila-actor.csv
Browse...
< Back
Next >
Cancel

Figure 6.19 Table Data Import: Destination Table

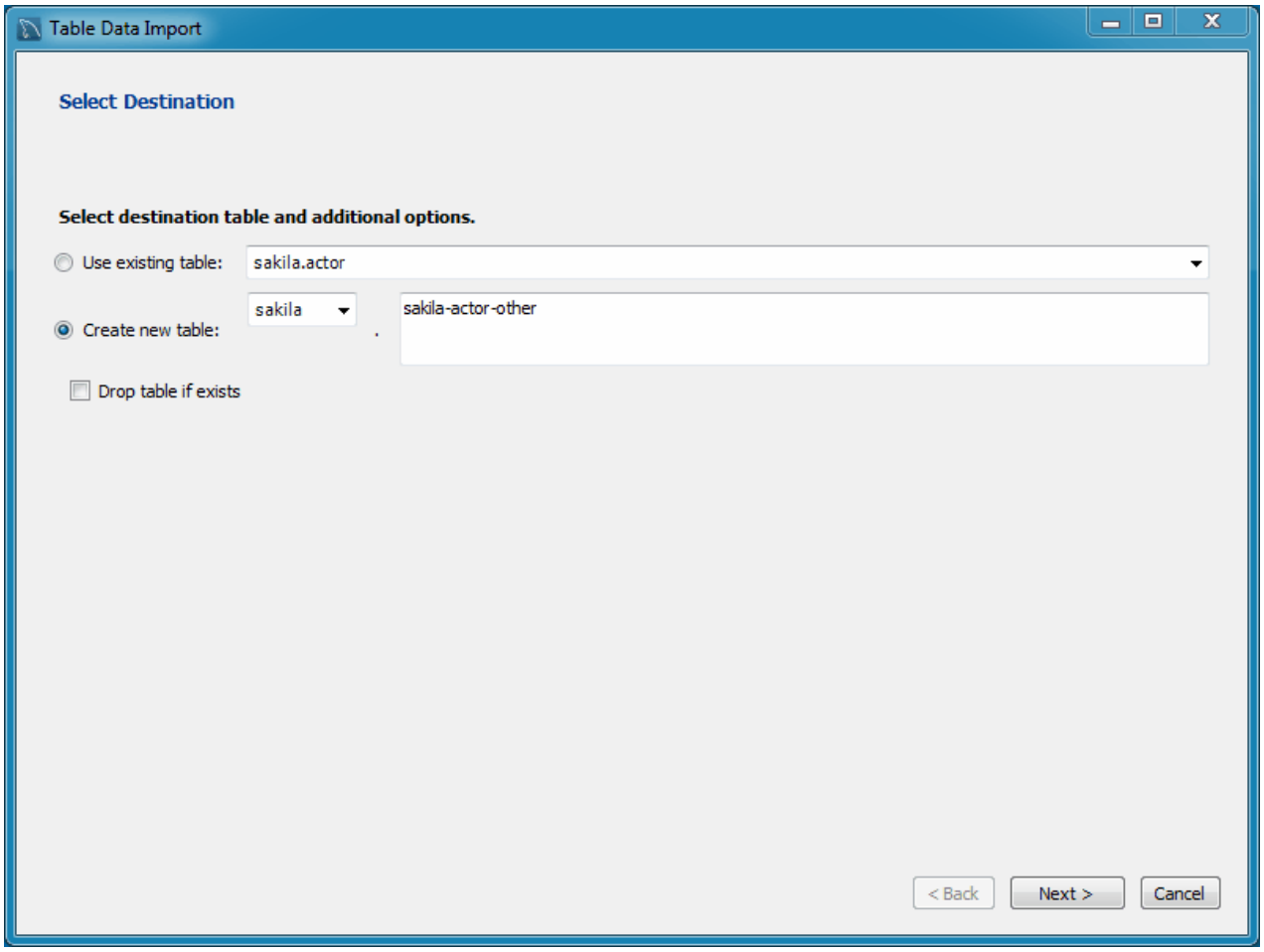
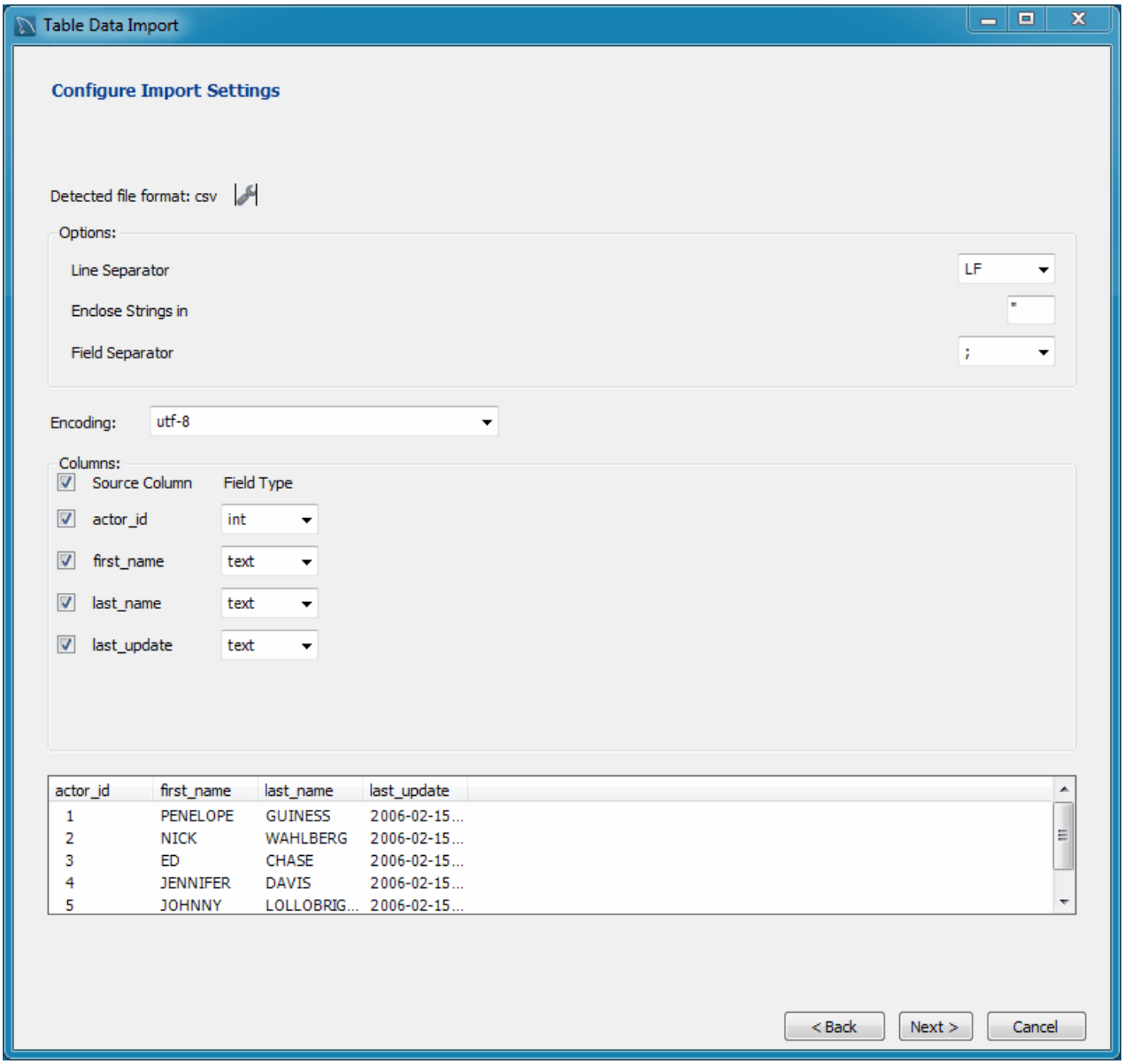


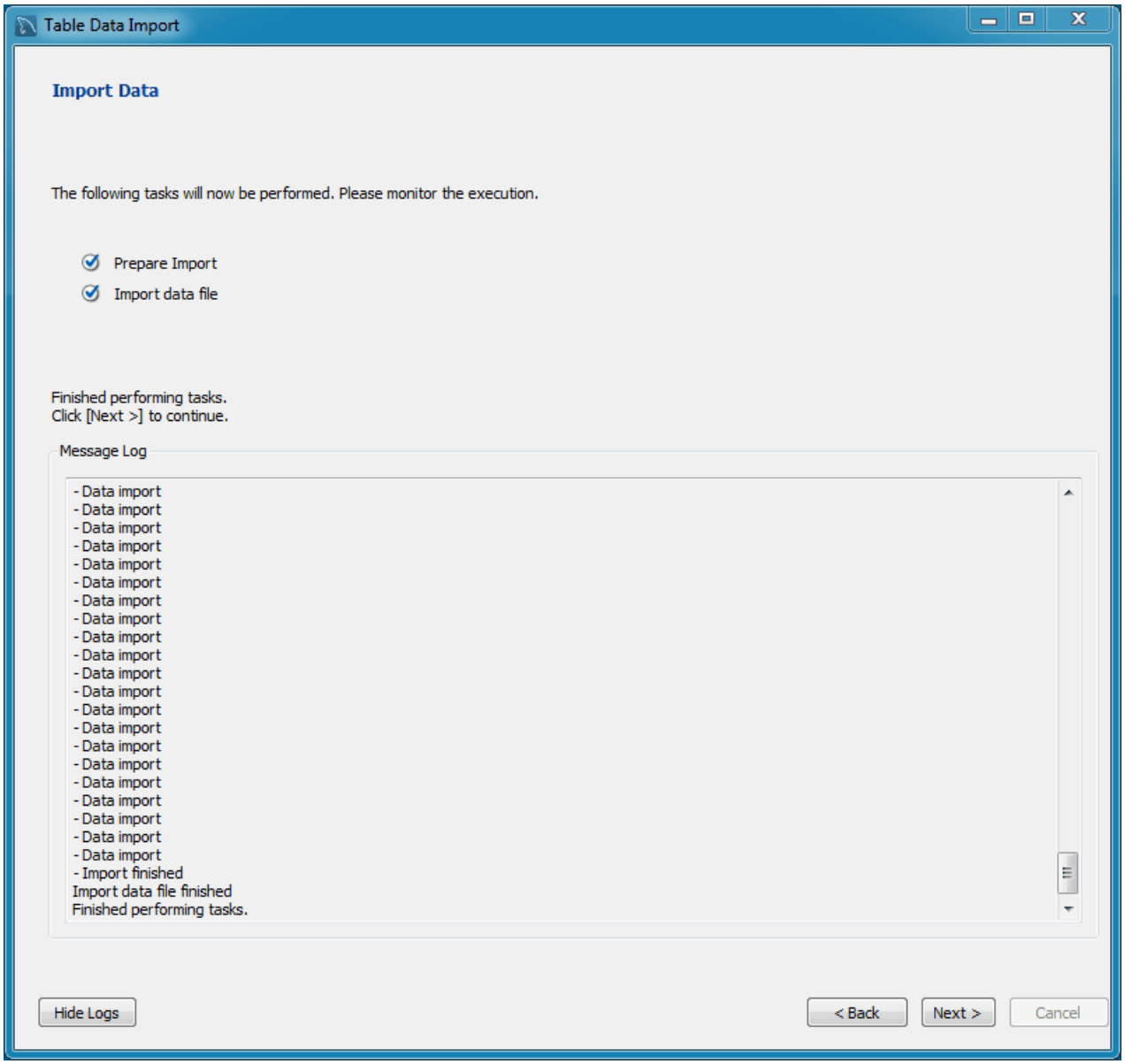
Figure 6.20 Table Data Import: CSV Configuration



Note

The **Encoding** field should correspond with your CSV file.

Figure 6.21 Table Data Import: Results



6.5.2 SQL Data Export and Import Wizard

From the management navigator, you can export or import SQL generated from MySQL Workbench or the `mysqldump` command.

Note

This wizard only exports/imports the MySQL SQL format. For an overview of the data export and import options in MySQL Workbench, see Section 6.5, “Data Export and Import”.

Data Export

This tab allows you to export your MySQL data. Select each schema you want to export, optionally choose specific schema objects/tables from each schema, and generate the export. Configuration options include

exporting to a project folder or self-contained SQL file, optionally dump stored routines and events, or skip table data.

Note

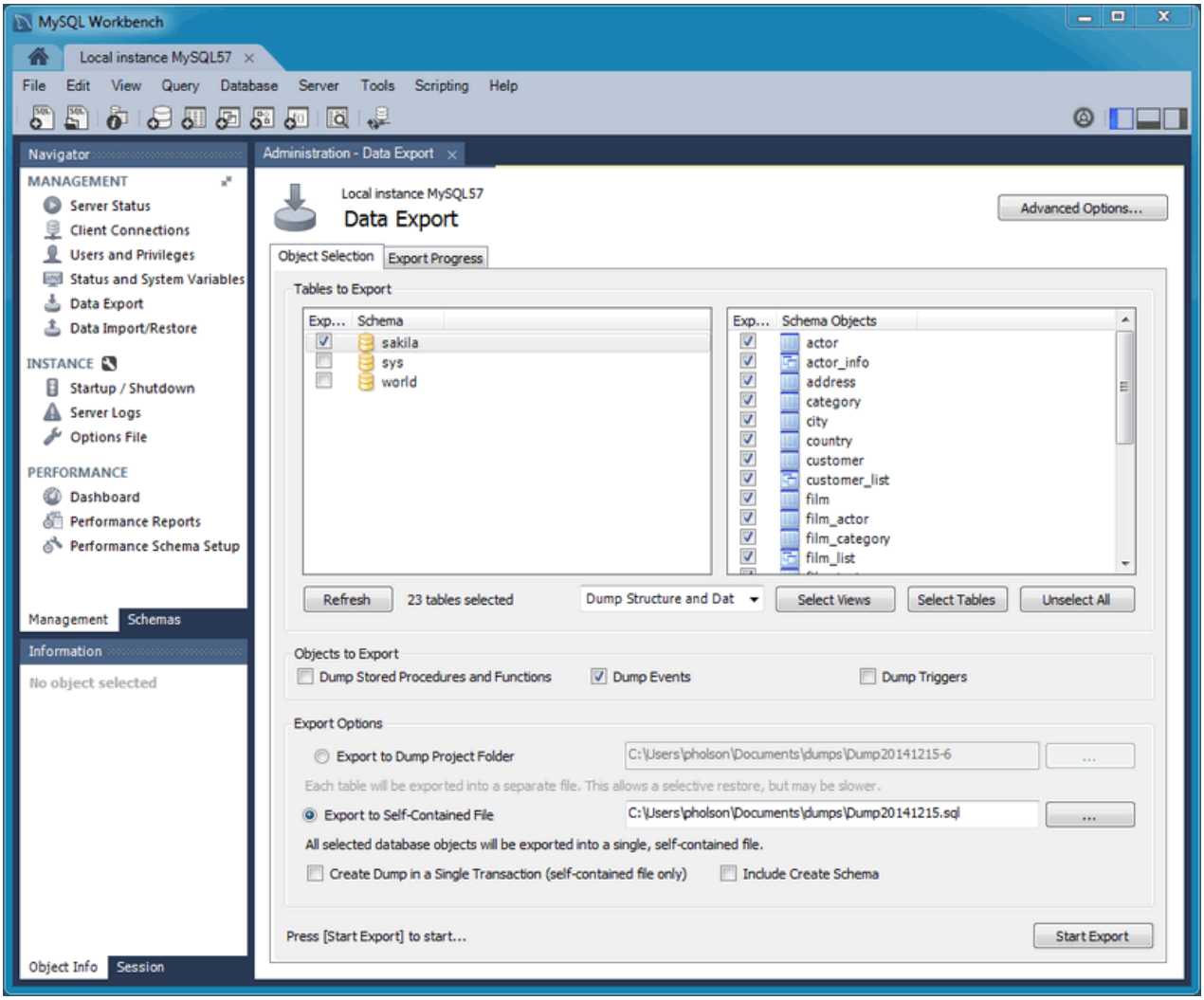
Alternatively, use Export a Result Set to export a specific result set in the SQL editor to another format such as CSV, JSON, HTML, and XML.

Select the Database objects to export, and configure the related options.

Note

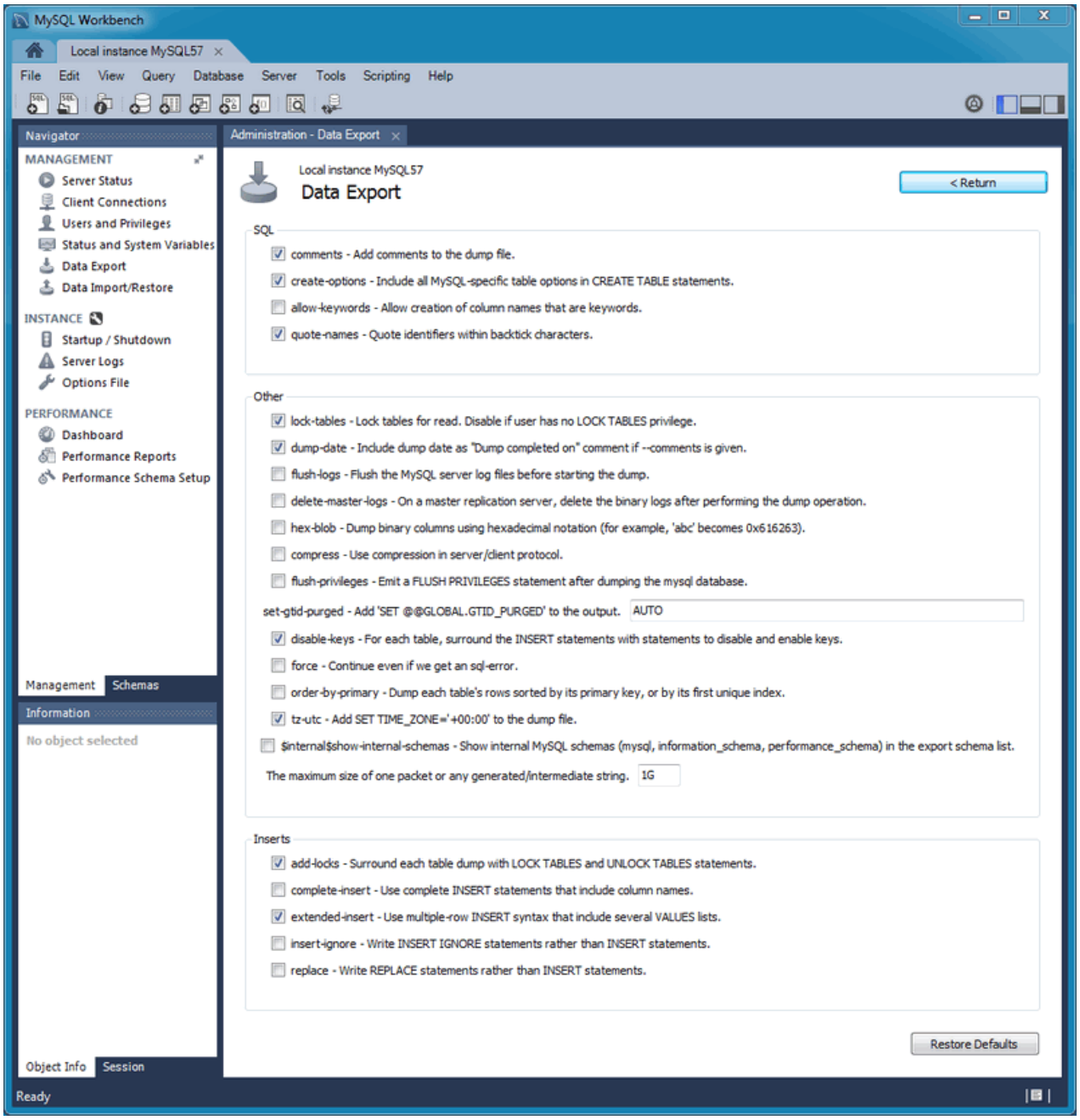
Click Refresh to load the current objects.

Figure 6.22 Navigator Management: Data Export: Object Selection



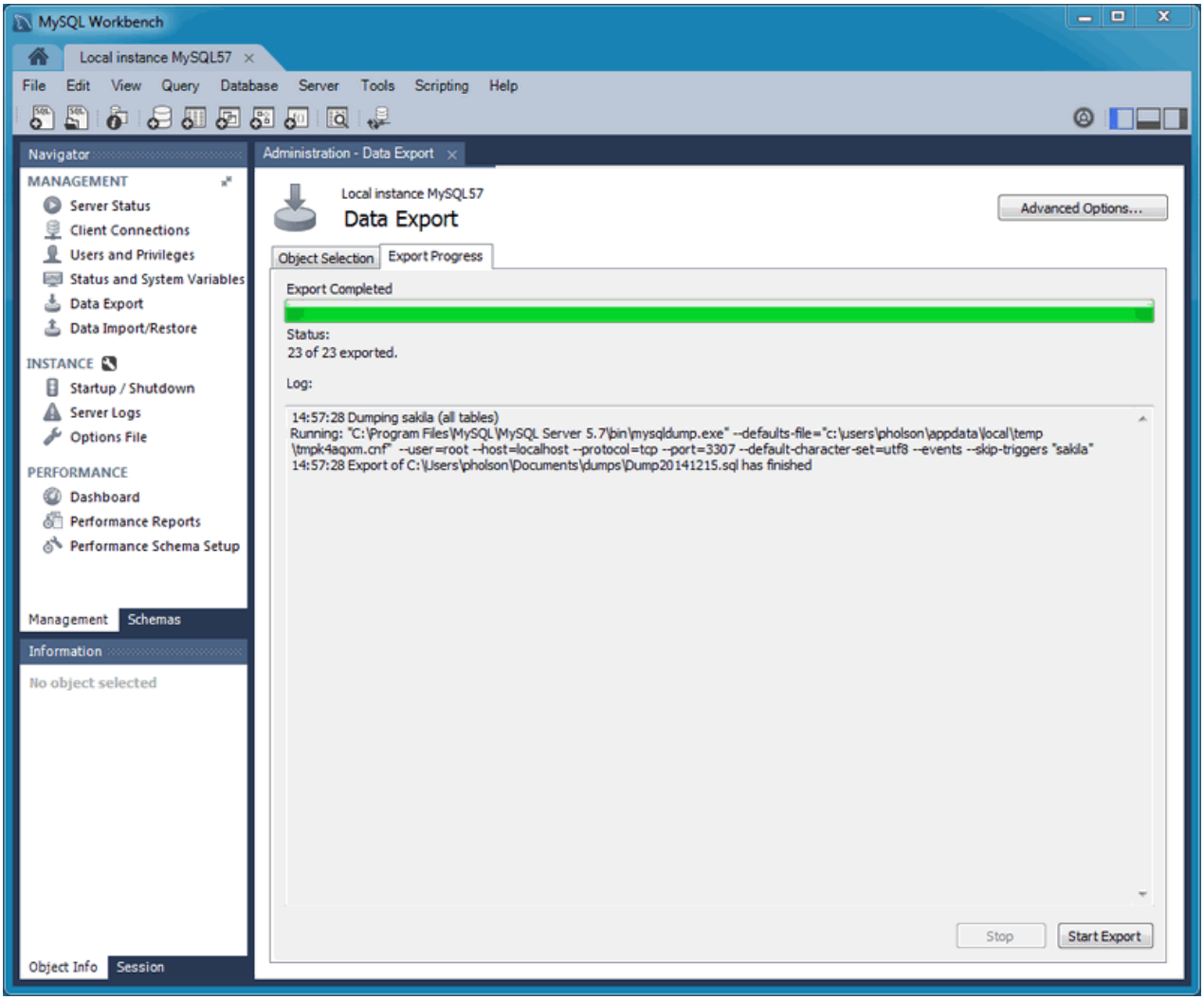
Optionally open the Advanced Options tab that allows you to refine the export operation. For example, add table locks, use replace instead of insert statements, quote identifiers with backtick characters, and more.

Figure 6.23 Navigator Management: Data Export: Advanced Options


MySQL Workbench
Local instance MySQL57
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
Administration - Data Export
Local instance MySQL57
Data Export
< Return
SQL
comments - Add comments to the dump file.
create-options - Include all MySQL-specific table options in CREATE TABLE statements.
allow-keywords - Allow creation of column names that are keywords.
quote-names - Quote identifiers within backtick characters.
Other
lock-tables - Lock tables for read. Disable if user has no LOCK TABLES privilege.
dump-date - Include dump date as "Dump completed on" comment if --comments is given.
flush-logs - Flush the MySQL server log files before starting the dump.
delete-master-logs - On a master replication server, delete the binary logs after performing the dump operation.
hex-blob - Dump binary columns using hexadecimal notation (for example, 'abc' becomes 0x616263).
compress - Use compression in server/client protocol.
flush-privileges - Emit a FLUSH PRIVILEGES statement after dumping the mysql database.
set-gtid-purged - Add 'SET @@GLOBAL.GTID_PURGED' to the output. AUTO
disable-keys - For each table, surround the INSERT statements with statements to disable and enable keys.
force - Continue even if we get an sql-error.
order-by-primary - Dump each table's rows sorted by its primary key, or by its first unique index.
tz-utc - Add SET TIME_ZONE='+00:00' to the dump file.
$internal$show-internal-schemas - Show internal MySQL schemas (mysql, information_schema, performance_schema) in the export schema list.
The maximum size of one packet or any generated/intermediate string. 1G
Inserts
add-locks - Surround each table dump with LOCK TABLES and UNLOCK TABLES statements.
complete-insert - Use complete INSERT statements that include column names.
extended-insert - Use multiple-row INSERT syntax that include several VALUES lists.
insert-ignore - Write INSERT IGNORE statements rather than INSERT statements.
replace - Write REPLACE statements rather than INSERT statements.
Restore Defaults
Ready

Click Start Export to begin the export process:

Figure 6.24 Navigator Management: Data Export: Export Progress



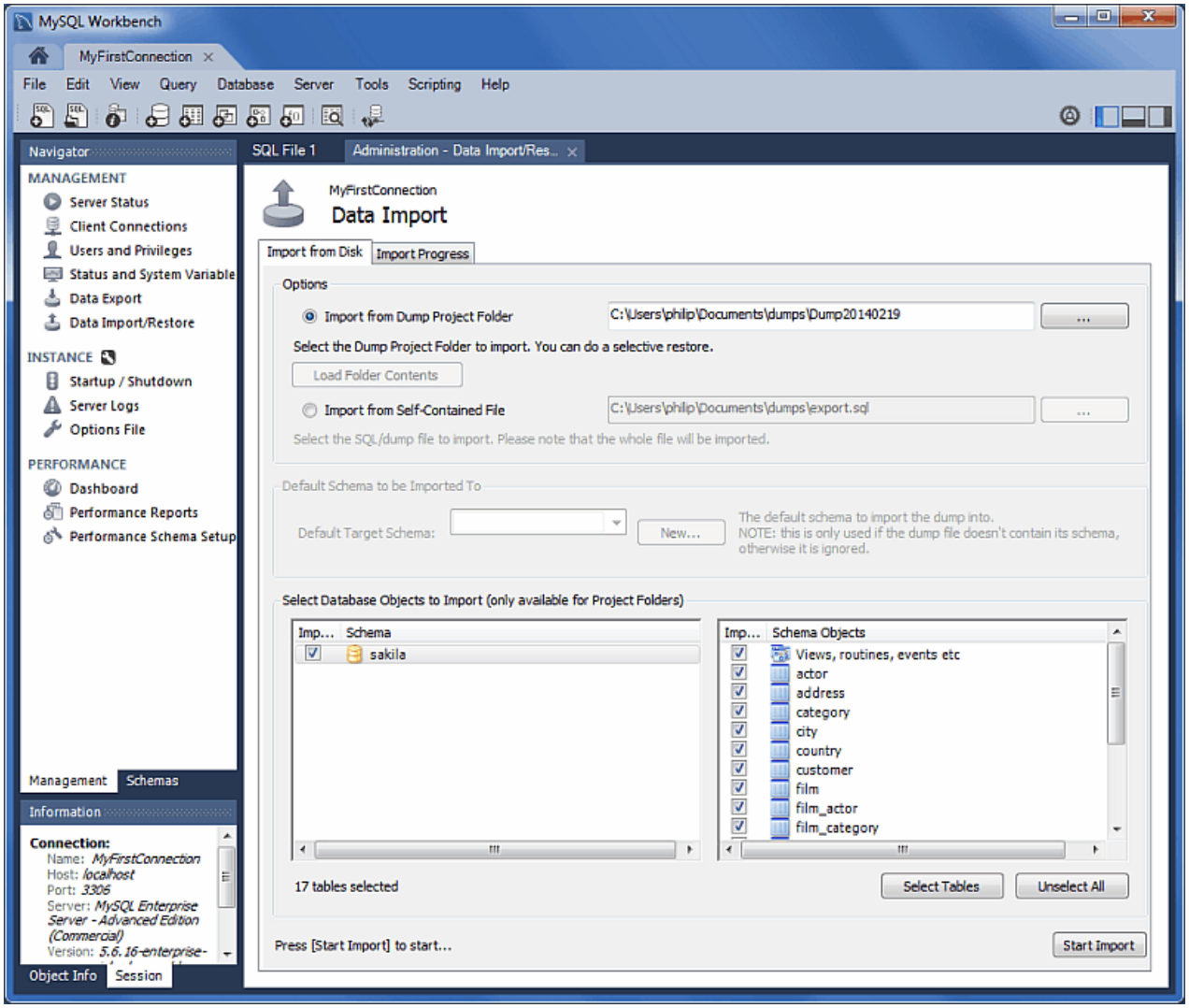
This functionality uses the `mysqldump` command.

Data Import/Restore

Restore exported data from the **Data Export** operation, or from other exported data from the `mysqldump` command.

Choose the project folder or self-contained SQL file, choose the schema that the data will be imported to, or choose New to define a new schema.

Figure 6.25 Navigator Management: Data Import: Import From Disk

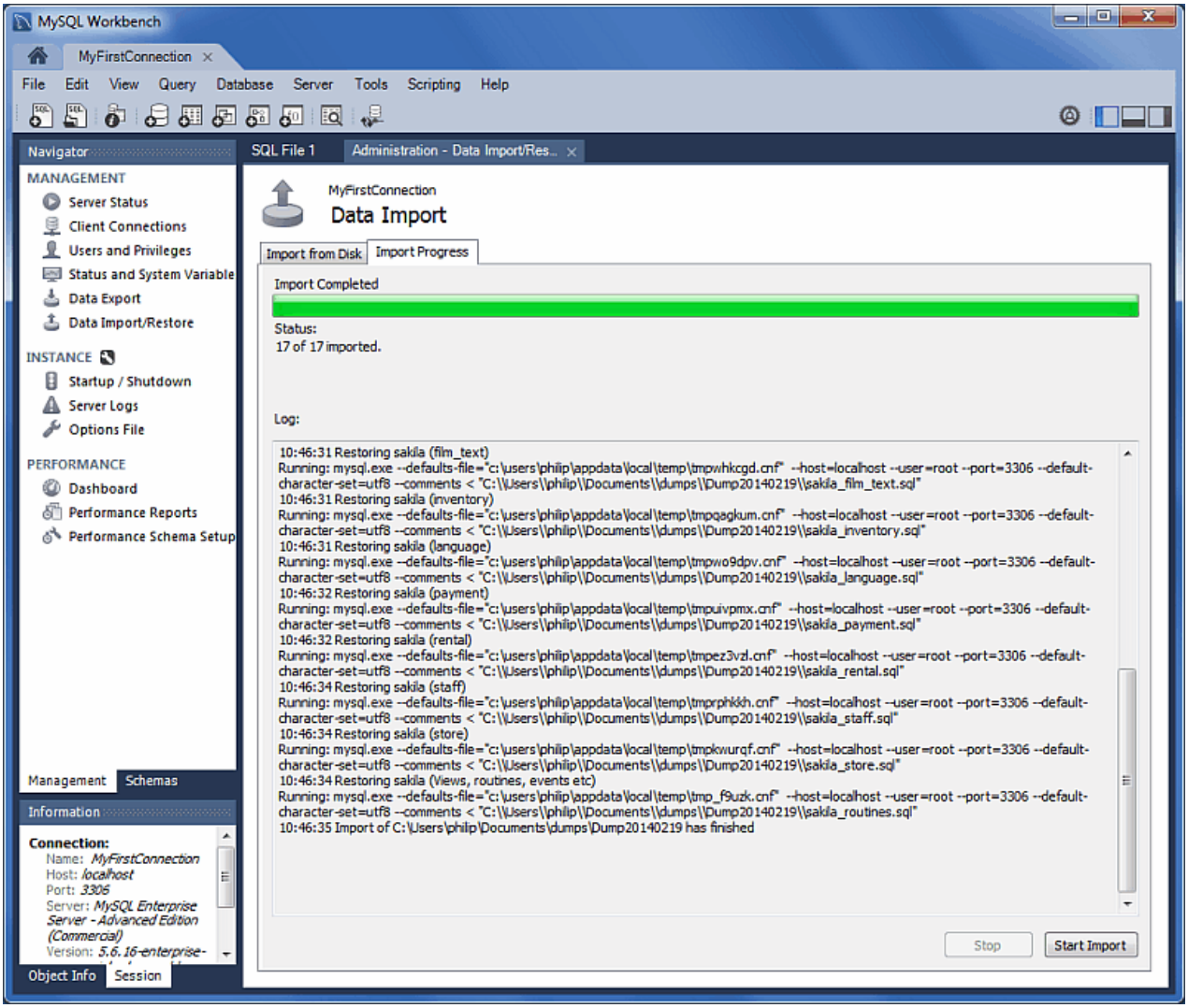


Note

You may only select specific data objects (tables) to import if the data export operation used project folders instead of a self-contained SQL file.

Click Start Import to begin the import process:

Figure 6.26 Navigator Management: Data Import: Import Progress



6.5.3 Result Data Export and Import

Export or Import data directly from or into the result set.

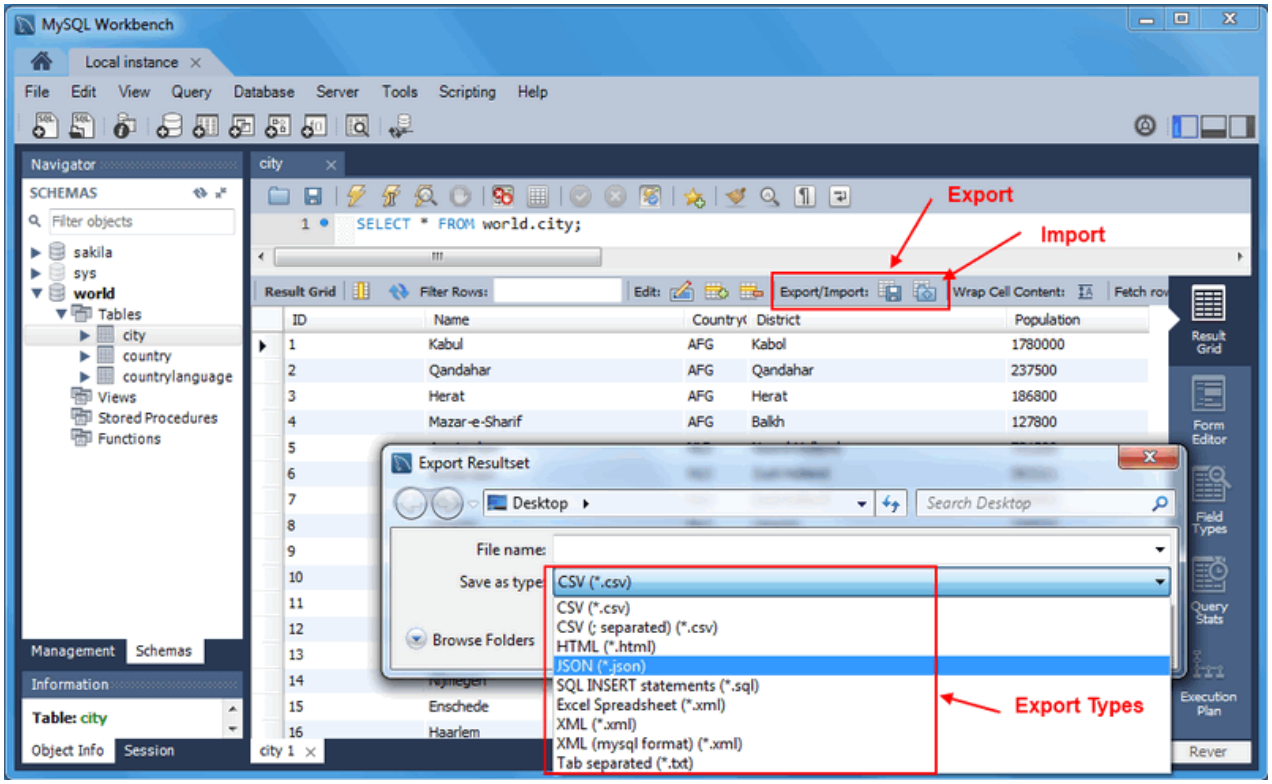
Export a Result Set

A result set in the visual SQL editor can be exported to common file formats including CSV, JSON, HTML, and XML.

Note

This wizard only exports/imports data from a result set. For an overview of the data export and import options in MySQL Workbench, see Section 6.5, “Data Export and Import”.

Figure 6.27 Exporting a Result Set



Import into a Result Set

Records from a CSV file can be imported into the result set of the visual SQL editor.

Note

The result set must have a unique row identifier (such as a Primary Key or NOT NULL unique index) as otherwise values can not be imported because the result set will be read-only.

Note

Alternatively, use Section 6.5, “Data Export and Import” to export larger sets of data, such as entire tables and databases.

6.6 MySQL Audit Inspector Interface

MySQL Workbench offers a GUI interface to the Audit Inspector.

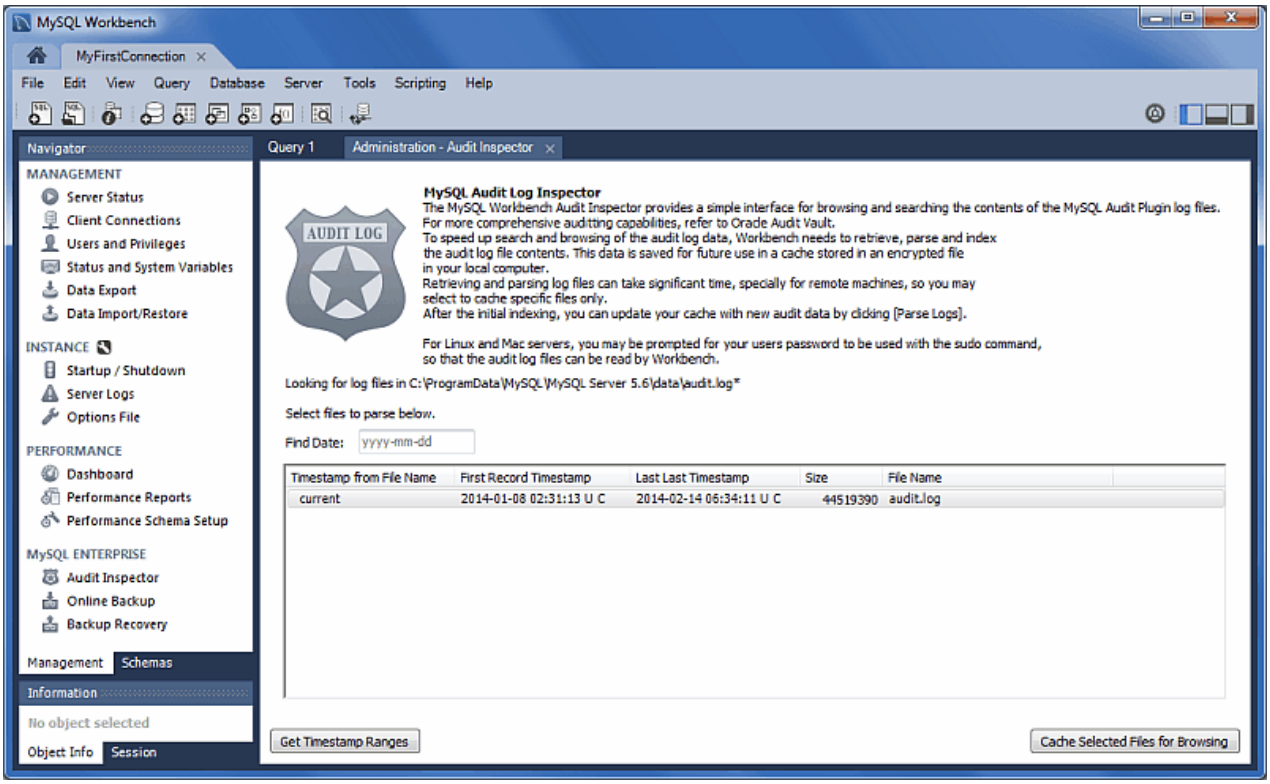
Initially, when you first load the **Audit Inspector**, you must use MySQL Workbench to cache the audit log for performance reasons. MySQL Workbench will then parse, index, and retrieve values from the encrypted cached file on your local computer.

Note

MySQL Workbench will prompt for **sudo** access if the MySQL Workbench user is unable to read the audit log file.

At this stage, you also set a password for the encrypted file that will be used when viewing this file. The initial screen looks similar to:

Figure 6.28 Workbench: Audit Inspector: Initializing

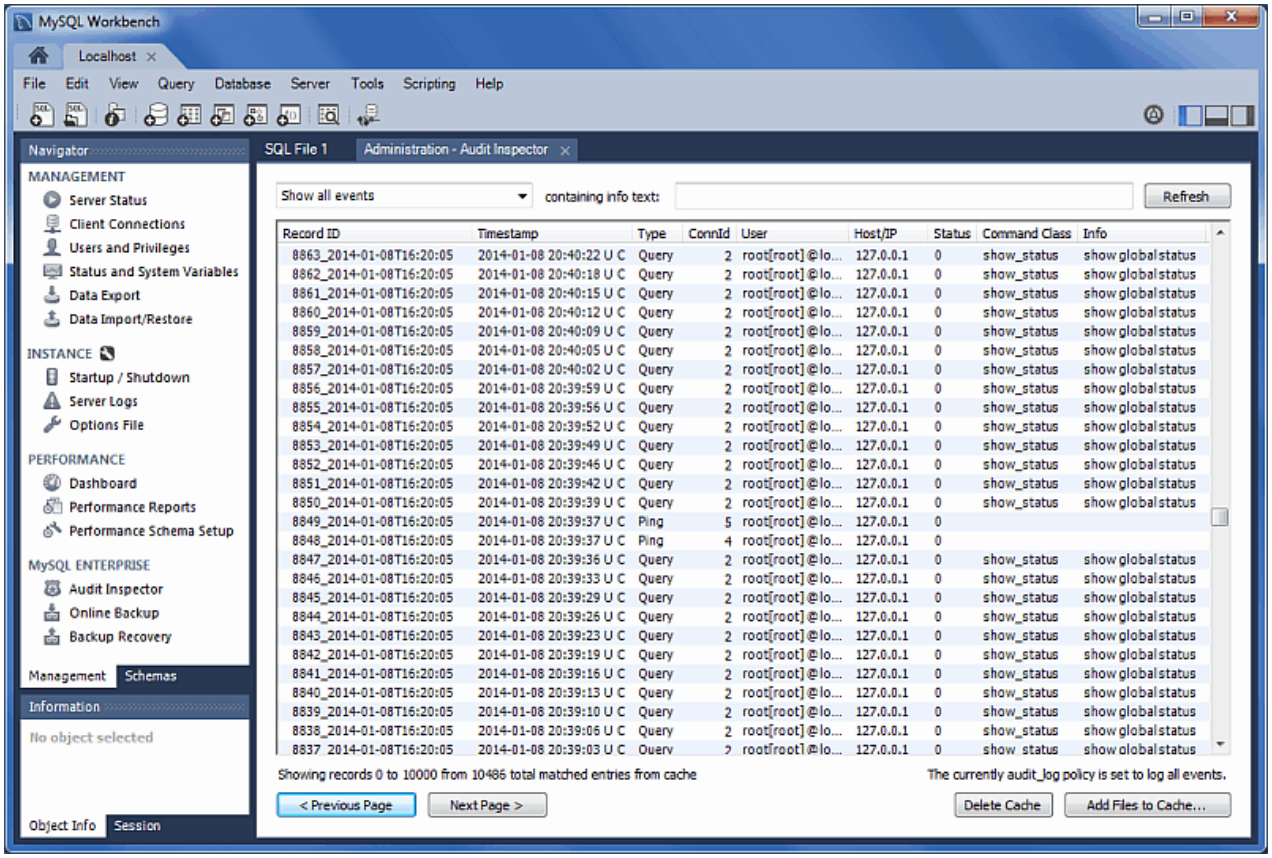

MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MySQL ENTERPRISE
Audit Inspector
Online Backup
Backup Recovery
Management Schemas
Information
No object selected
Object Info Session
Query 1
Administration - Audit Inspector
AUDIT LOG
MySQL Audit Log Inspector
The MySQL Workbench Audit Inspector provides a simple interface for browsing and searching the contents of the MySQL Audit Plugin log files.
For more comprehensive auditing capabilities, refer to Oracle Audit Vault.
To speed up search and browsing of the audit log data, Workbench needs to retrieve, parse and index
the audit log file contents. This data is saved for future use in a cache stored in an encrypted file
in your local computer.
Retrieving and parsing log files can take significant time, specially for remote machines, so you may
select to cache specific files only.
After the initial indexing, you can update your cache with new audit data by clicking [Parse Logs].
For Linux and Mac servers, you may be prompted for your users password to be used with the sudo command,
so that the audit log files can be read by Workbench.
Looking for log files in C:\ProgramData\MySQL\MySQL Server 5.6\data\audit.log*
Select files to parse below.
Find Date: yyyy-mm-dd
Timestamp from File Name
First Record Timestamp
Last Last Timestamp
Size
File Name
current
2014-01-08 02:31:13 U C
2014-02-14 06:34:11 U C
44519390
audit.log
Get Timestamp Ranges
Cache Selected Files for Browsing

Note

Generating the cache file can take a long time. If you press Abort during the caching process, MySQL Workbench will save the results that were cached at the point you pressed Abort.

After caching an audit log, the **Audit Inspector** page will display the results:

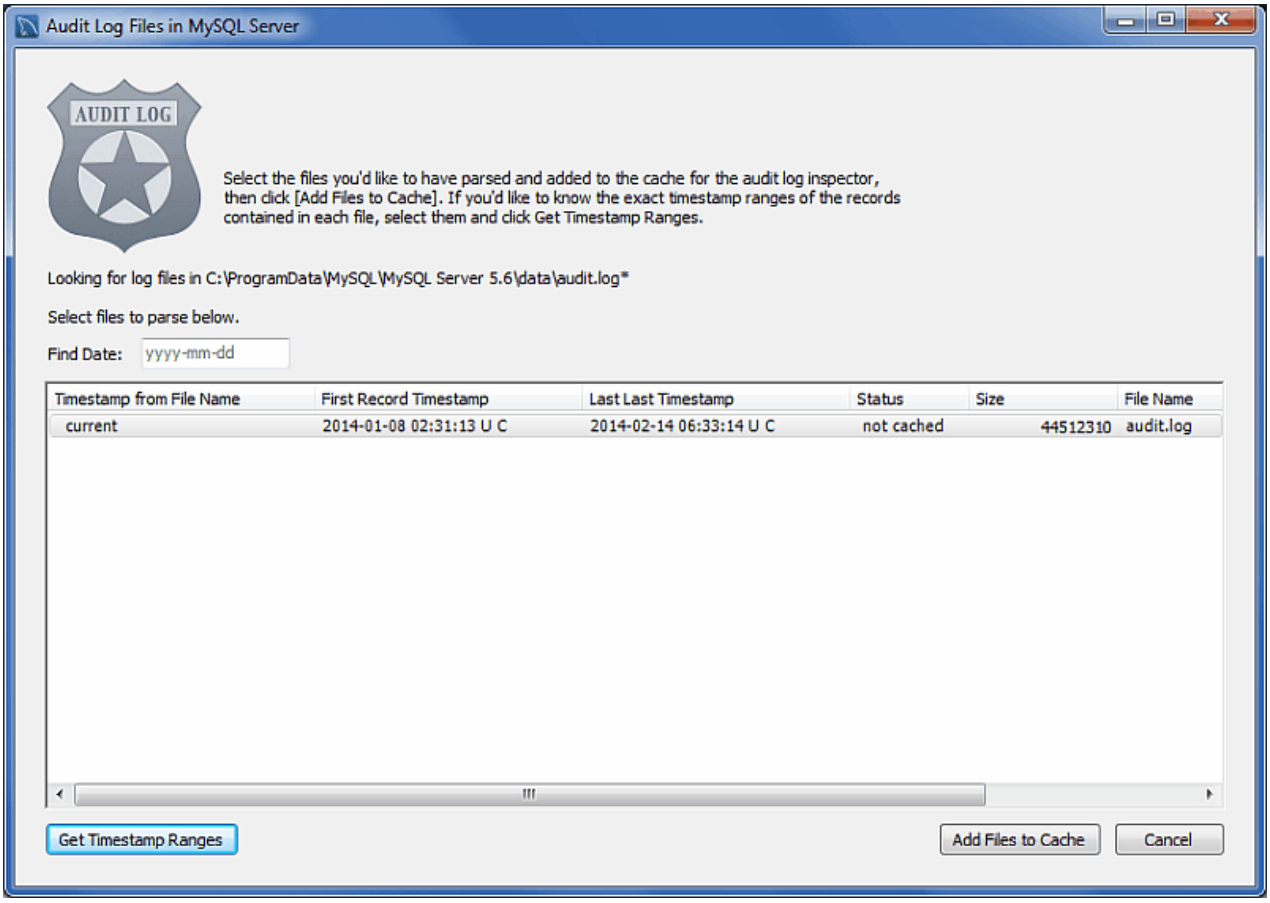
Figure 6.29 Workbench: Audit Inspector


MySQL Workbench
Localhost
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MySQL ENTERPRISE
Audit Inspector
Online Backup
Backup Recovery
Management Schemas
Information
No object selected
Object Info Session
SQL File 1
Administration - Audit Inspector
Show all events
containing info text:
Refresh
Record ID Timestamp Type ConnId User Host/IP Status Command Class Info
8863_2014-01-08T16:20:05 2014-01-08 20:40:22 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8862_2014-01-08T16:20:05 2014-01-08 20:40:18 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8861_2014-01-08T16:20:05 2014-01-08 20:40:15 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8860_2014-01-08T16:20:05 2014-01-08 20:40:12 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8859_2014-01-08T16:20:05 2014-01-08 20:40:09 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8858_2014-01-08T16:20:05 2014-01-08 20:40:05 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8857_2014-01-08T16:20:05 2014-01-08 20:40:02 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8856_2014-01-08T16:20:05 2014-01-08 20:39:59 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8855_2014-01-08T16:20:05 2014-01-08 20:39:56 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8854_2014-01-08T16:20:05 2014-01-08 20:39:52 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8853_2014-01-08T16:20:05 2014-01-08 20:39:49 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8852_2014-01-08T16:20:05 2014-01-08 20:39:46 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8851_2014-01-08T16:20:05 2014-01-08 20:39:42 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8850_2014-01-08T16:20:05 2014-01-08 20:39:39 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8849_2014-01-08T16:20:05 2014-01-08 20:39:37 U C Ping 5 root[root] @lo... 127.0.0.1 0
8848_2014-01-08T16:20:05 2014-01-08 20:39:37 U C Ping 4 root[root] @lo... 127.0.0.1 0
8847_2014-01-08T16:20:05 2014-01-08 20:39:36 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8846_2014-01-08T16:20:05 2014-01-08 20:39:33 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8845_2014-01-08T16:20:05 2014-01-08 20:39:29 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8844_2014-01-08T16:20:05 2014-01-08 20:39:26 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8843_2014-01-08T16:20:05 2014-01-08 20:39:23 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8842_2014-01-08T16:20:05 2014-01-08 20:39:19 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8841_2014-01-08T16:20:05 2014-01-08 20:39:16 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8840_2014-01-08T16:20:05 2014-01-08 20:39:13 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8839_2014-01-08T16:20:05 2014-01-08 20:39:10 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8838_2014-01-08T16:20:05 2014-01-08 20:39:06 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
8837_2014-01-08T16:20:05 2014-01-08 20:39:03 U C Query 2 root[root] @lo... 127.0.0.1 0 show_status show global status
Showing records 0 to 10000 from 10486 total matched entries from cache
The currently audit_log policy is set to log all events.
< Previous Page
Next Page >
Delete Cache
Add Files to Cache...

The search field offers criteria for narrowing the displayed events, including Show events of type Fetch and Show events of type Query, and defaults to Show all events. Custom filters are also available.

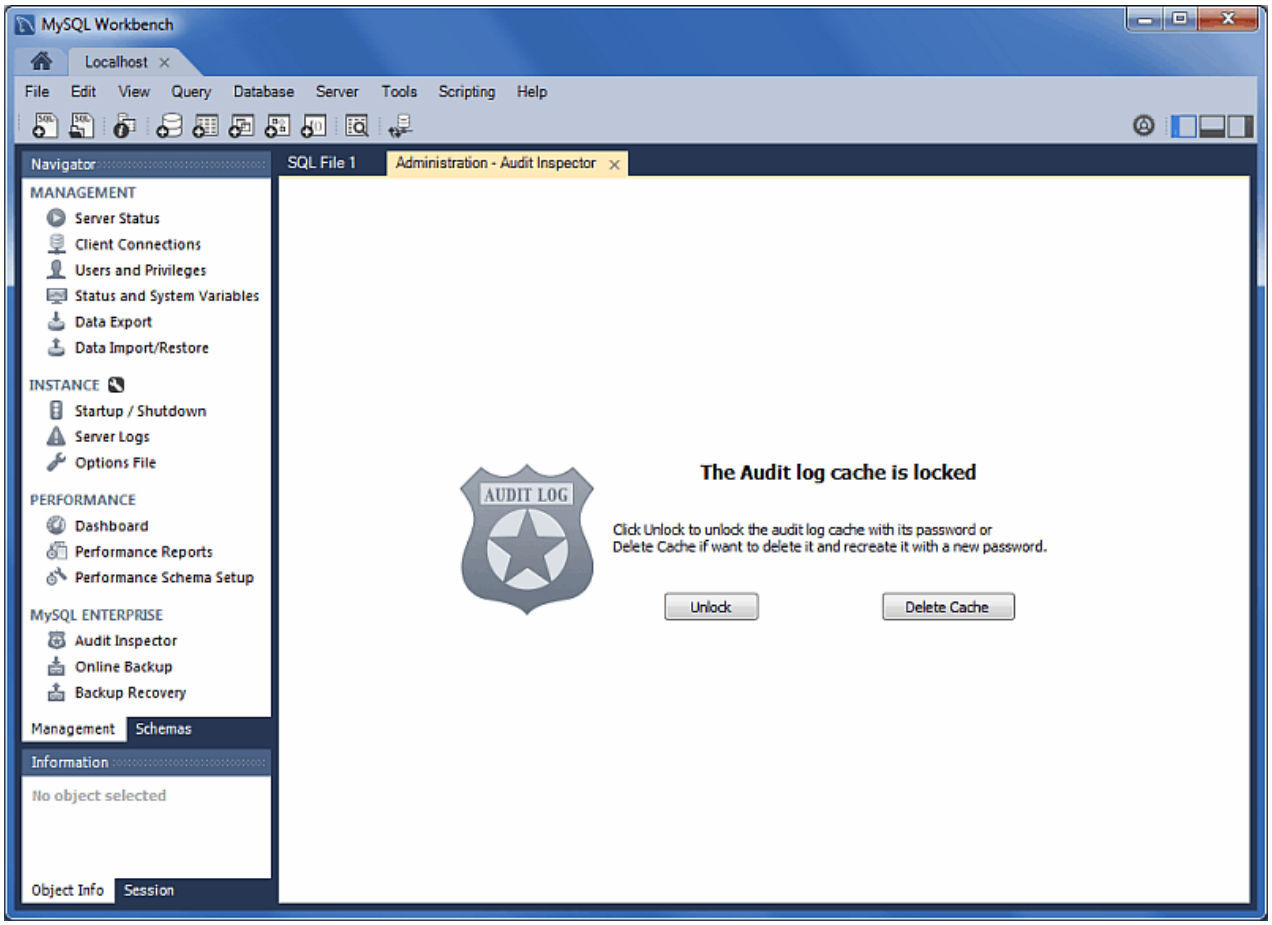
You can Add Files to Cache from the main Audit Inspector page:

Figure 6.30 Workbench: Audit Inspector: Add Files to Cache


Audit Log Files in MySQL Server
AUDIT LOG
Select the files you'd like to have parsed and added to the cache for the audit log inspector, then click [Add Files to Cache]. If you'd like to know the exact timestamp ranges of the records contained in each file, select them and click Get Timestamp Ranges.
Looking for log files in C:\ProgramData\MySQL\MySQL Server 5.6\data\audit.log*
Select files to parse below.
Find Date:
yyyy-mm-dd
Timestamp from File Name
First Record Timestamp
Last Last Timestamp
Status
Size
File Name
current
2014-01-08 02:31:13 U C
2014-02-14 06:33:14 U C
not cached
44512310
audit.log
Get Timestamp Ranges
Add Files to Cache
Cancel

Future uses of the Audit Inspector will require the password that you set during the initial step. The login page:

Figure 6.31 Workbench: Audit Inspector: Unlock



6.7 MySQL Enterprise Backup Interface

MySQL Workbench include a MySQL Enterprise Backup GUI interface that is listed in the Management Navigator tab for a MySQL connection. There are two MySQL Enterprise Backup related sections in the Navigator:

- **Online Backup**: Sets a backup profile that defines `what` should be backed up, `where` the backup should be stored, and `when` (the frequency) MySQL should be backed up.
- **Restore**: Restores the MySQL server to a specific point in time, typically by restoring a backup that was created by the **Online Backup** feature in MySQL Workbench.

For information comparing the different methods to import/export data using MySQL Workbench, see Section 6.5, “Data Export and Import”.

The MySQL Enterprise Backup configuration is located on the MySQL server, and not locally. This information includes the MySQL Enterprise Backup configuration backup profiles, job scheduling, backup operations, and data. This also means that the backup operations are executed with (or without) MySQL Workbench running.

6.7.1 General Requirements

MySQL Enterprise Backup is a MySQL Enterprise Feature that is separate from MySQL Workbench. For more information about its functionality, see the MySQL Enterprise Backup documentation at http://

dev.mysql.com/doc/mysql-enterprise-backup/en. MySQL Workbench provides an interface to MySQL Enterprise Backup, as described in the following documentation. In addition to having MySQL Enterprise Backup installed on your host, the following general requirements also apply:

- A recent version of MySQL Enterprise Backup. The MySQL Enterprise Backup support policy is to support the current GA version of MySQL Enterprise Backup, and the major version before that. This dictates the minimum MySQL Enterprise Backup version required by MySQL Workbench, which is the major version before the current GA release.
- Managing both local and remote MySQL instances is available on Linux and OS X, and managing local MySQL instances is available on Microsoft Windows. Remote management is configured using SSH Remote Management.
- A MySQL connection with a root user.
- The MySQL server configuration file path must be set and correct for the MySQL connection.
- The user running MySQL Workbench must be a sudoer (Linux / OS X) that is able to execute the MySQL Enterprise Backup binary.
- Additionally, the sudo user must keep the `HOME` environment variable when executing system commands, which means adding the following to `/etc/sudoers`:

```
env_keep +="HOME"
```

And the **Prerequisites** set in the Settings tab are:

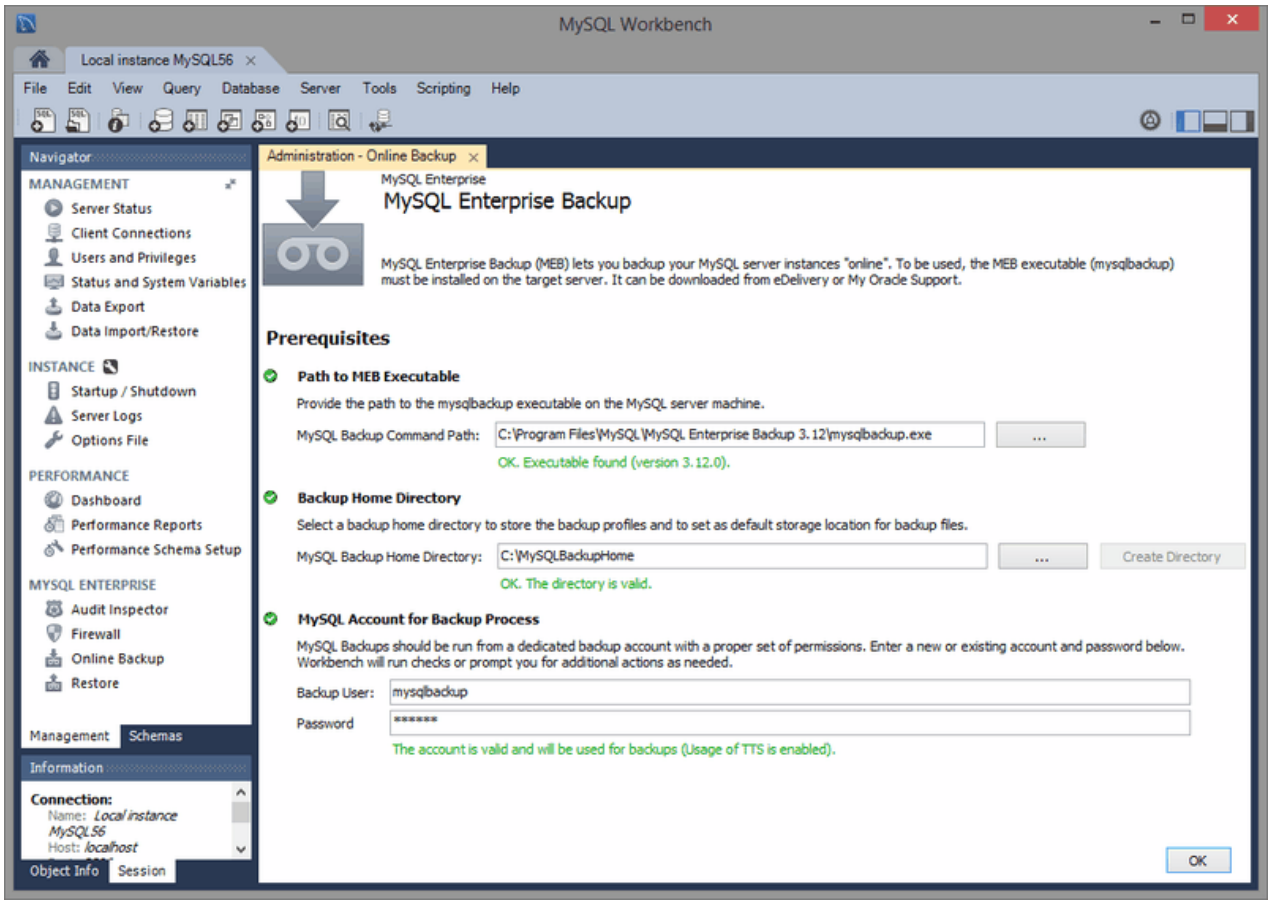
- A path to the MySQL Enterprise Backup executable. MySQL Enterprise Backup is available via eDelivery or My Oracle Support (MOS). MySQL Workbench attempts to locate the MySQL Enterprise Backup executable, so check the path and adjust it accordingly.
- The path to the **Backup Home Directory**, where backup profiles and data is stored. This can be created from within Workbench from the **Settings** tab.
- The MySQL account for the **Backup Process**. The available actions depends on the current state of this set up, with options including:
  - Create MEB Account: Available if a backup user does not already exist.
  - Change Password: Available if a backup user does exist.
  - Fix Grants for MEB...: Available if the user's privileges are invalid, which alters the user by adding the `RELOAD`, `SUPER`, and `REPLICATION CLIENT ON *.*` privileges.

Uninstallation notes

- The MySQL Workbench uninstallation process does not remove the associated MySQL Enterprise Backup backup tasks. To stop the scheduled backups, edit the related "Task Scheduler" entries on Windows, or remove the associated cron jobs on Linux and OS X.
- The MySQL Workbench uninstallation process does not remove the MySQL Enterprise Backup master related configuration file, the configuration files generated for each defined profile, nor the MySQL backups.

The Settings tab:

Figure 6.32 Workbench: MySQL Enterprise Backup Settings

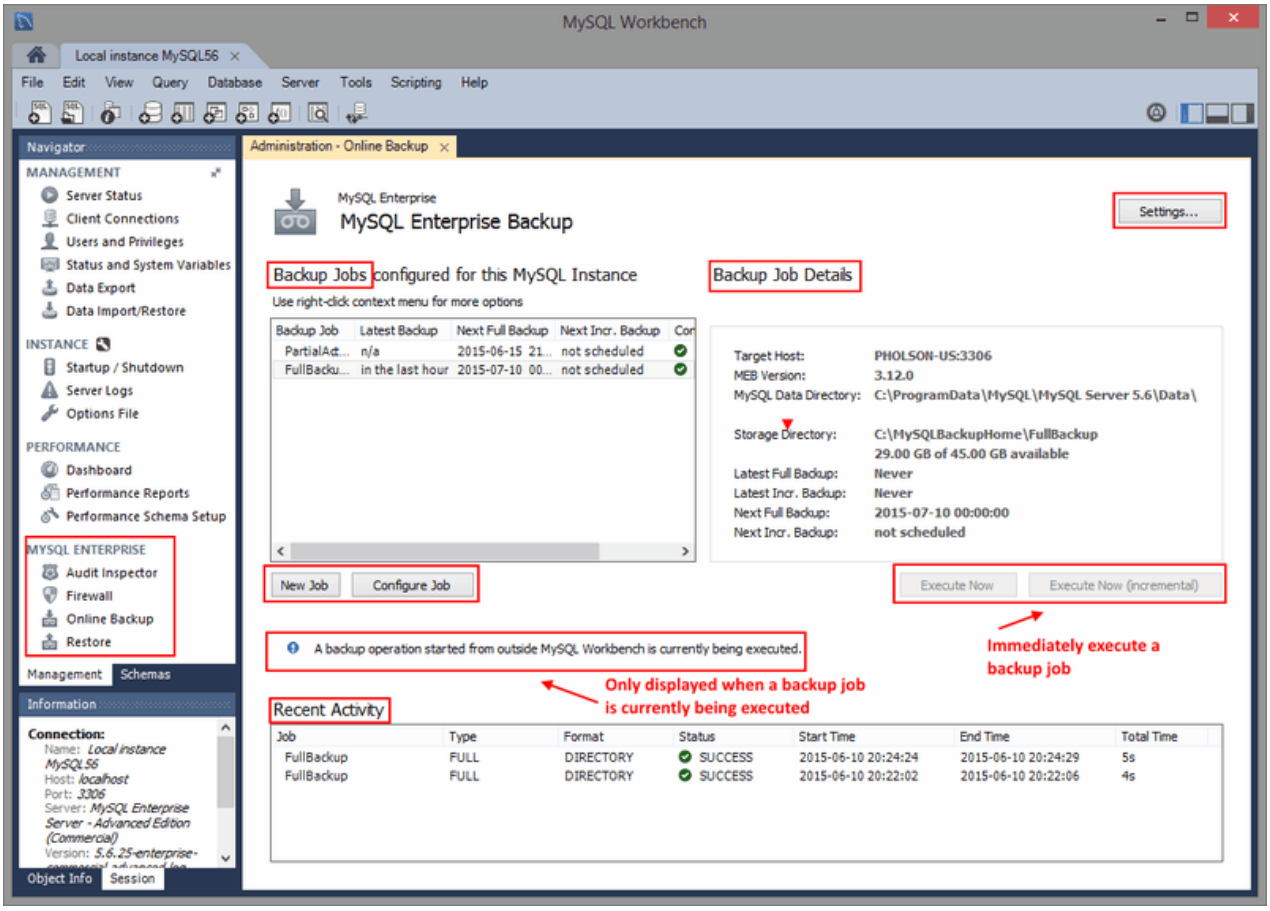

MySQL Workbench
Local instance MySQL56
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MYSQL ENTERPRISE
Audit Inspector
Firewall
Online Backup
Restore
Management Schemas
Information
Connection:
Name: Local instance MySQL56
Host: localhost
Object Info Session
Administration - Online Backup
MySQL Enterprise
MySQL Enterprise Backup
MySQL Enterprise Backup (MEB) lets you backup your MySQL server instances "online". To be used, the MEB executable (mysqlbackup) must be installed on the target server. It can be downloaded from eDelivery or My Oracle Support.
Prerequisites
Path to MEB Executable
Provide the path to the mysqlbackup executable on the MySQL server machine.
MySQL Backup Command Path: C:\Program Files\MySQL\MySQL Enterprise Backup 3.12\mysqlbackup.exe
OK. Executable found (version 3.12.0).
Backup Home Directory
Select a backup home directory to store the backup profiles and to set as default storage location for backup files.
MySQL Backup Home Directory: C:\MySQLBackupHome
Create Directory
OK. The directory is valid.
MySQL Account for Backup Process
MySQL Backups should be run from a dedicated backup account with a proper set of permissions. Enter a new or existing account and password below. Workbench will run checks or prompt you for additional actions as needed.
Backup User: mysqlbackup
Password ******
The account is valid and will be used for backups (Usage of TTS is enabled).
OK

If any of the requirements are not met, then an error will be generated when attempting to use MySQL Enterprise Backup features.

6.7.2 Online Backup

Sets a backup profile that defines `what` should be backed up, `where` the backup should be stored, and `when` (the frequency) it should be backed up. The main page:

Figure 6.33 Workbench: MySQL Enterprise Backup



The **Online Backup** page is separated into three sections:

- **Backup Jobs**: Used for managing backup jobs for the MySQL server. A backup job (profile) is a configuration file used to store information about what is backed up, where the backup is stored, and optionally when backups will be performed.

  Right-clicking on a Backup Job is an alternative way to access the available actions, such as `Configure Job`, `Delete Job`, and `Execute Backup`. Right-clicking also offers two additional options:

  - Execute Backup to Image File: Saves the backup to a single file, and prompts for the file name.
  - Copy Backup Command to Clipboard: Generates a command for executing the backup, and copies it to your clipboard. You might execute this command in the shell or terminal, which looks similar to: `/bin/mysqlbackup --defaults-file="/var/lib/meb/foo.cnf" --show-progress=stdout backup --with-timestamp`.

- **Backup Job Details**: Displays information about the state of a specific (selected) backup job. It includes information from the Settings page, and information specific to the selected backup.

- **Recent Activity**: Historical information about the backup operations performed on the server. View the backup log by right-clicking an entry and choosing `View Backup Log`

A progress dialog is generated for the backup operation.

Backup Jobs

The following information applies to the New Job operation, and Configure Job is used to modify existing jobs.

The **Backup Profile Name** and its associated **Comments** field are used to identify the backup job's profile, and this name is listed on the main page.

The New Job scheduling page separates the configuration information into four tabs. The **Contents** tab defines the schemas and tables to back up, and whether the job is a full or partial backup.

- `Full backup`: All schemas and tables are backed up.
- `Partial`: Select the schemas and tables (objects) that you want to back up. Choose **Select objects to included/excluded** to open the table inclusion (and exclusion) options. For additional information about the include, exclude, and **Transportable Tablespace** options, see the MySQL Enterprise Backup documentation titled Partial Backup and Restore Options.

Figure 6.34 Workbench: MySQL Enterprise Backup Configuration: Contents for Full Backups

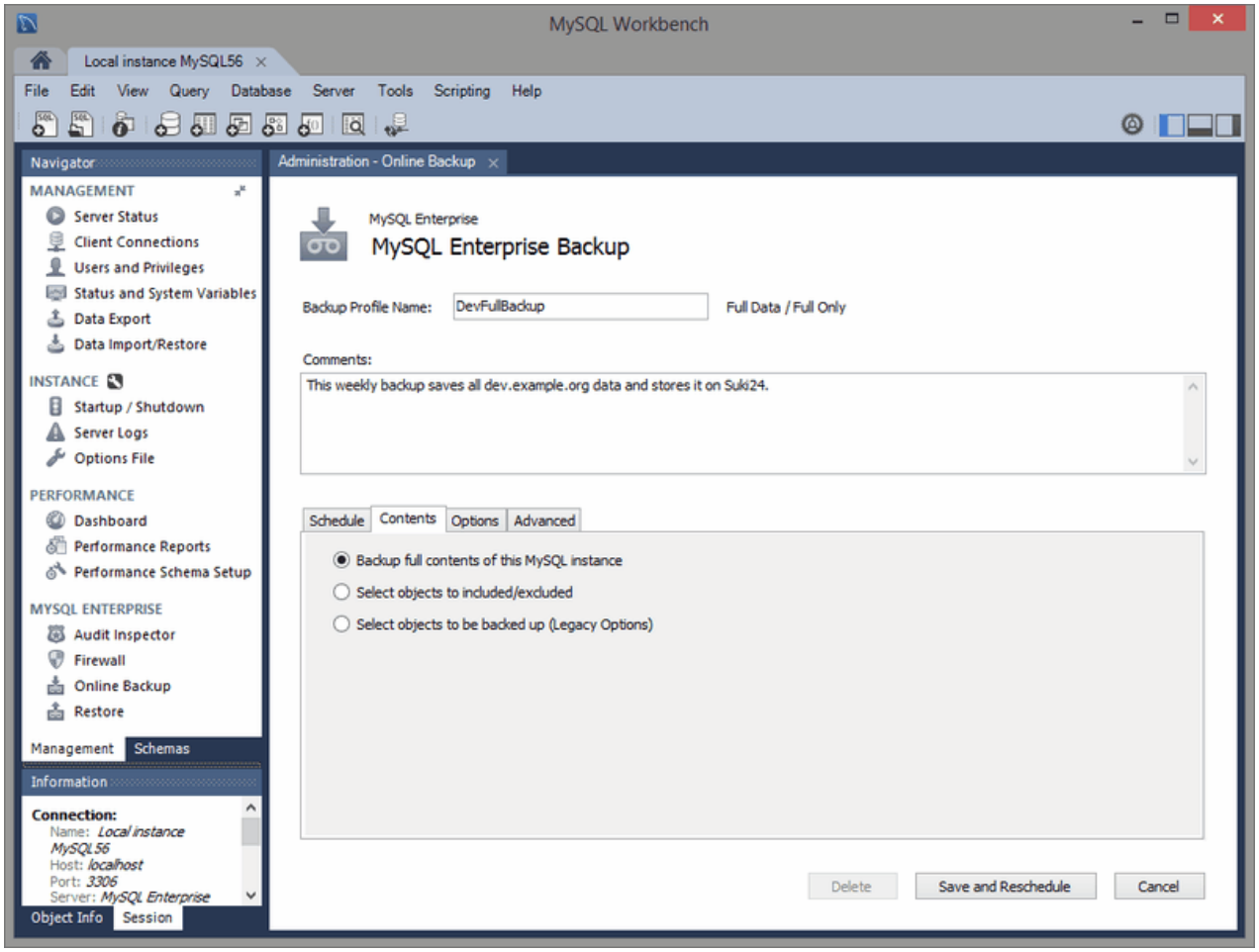
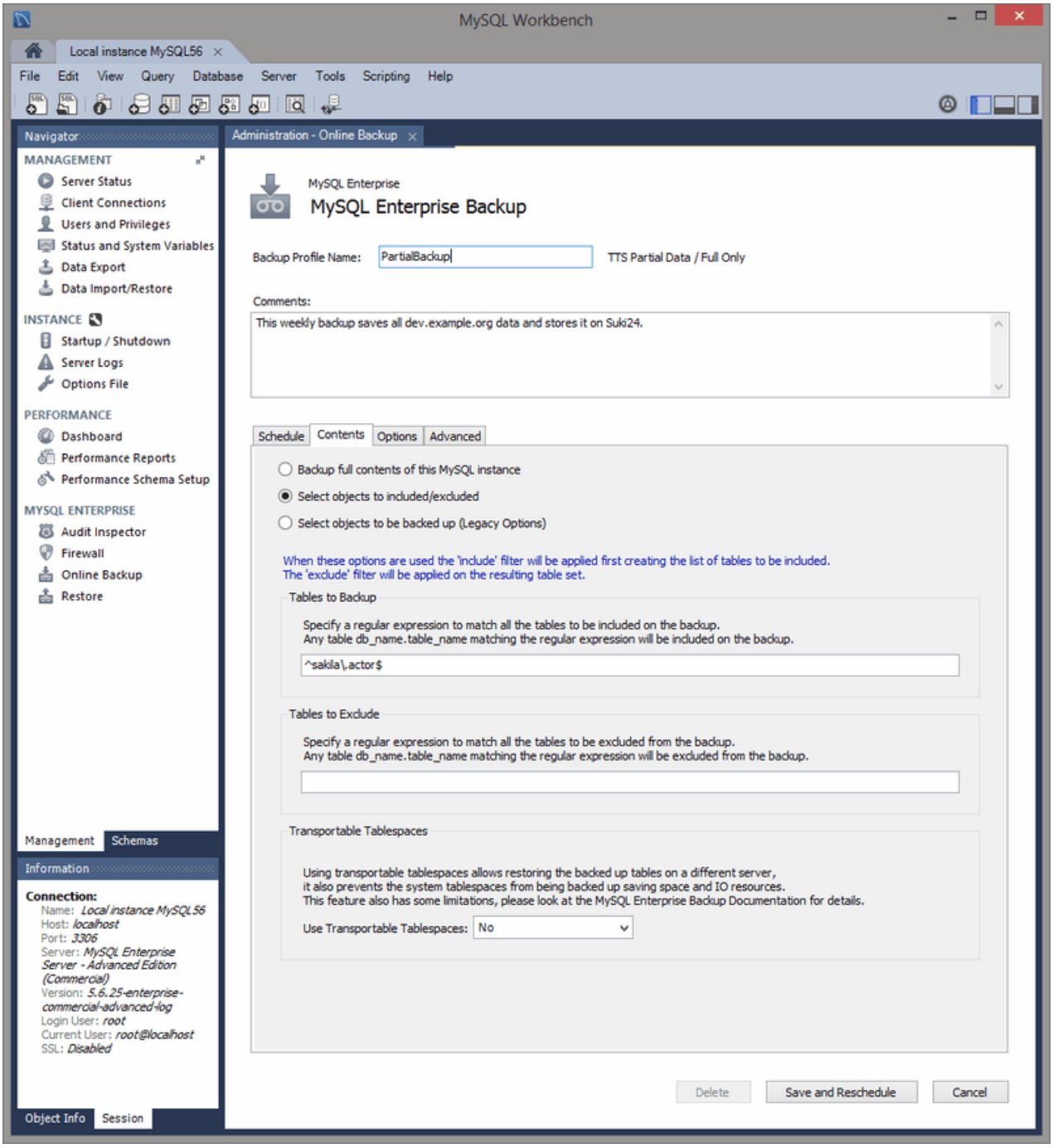


Figure 6.35 Workbench: MySQL Enterprise Backup Configuration: Contents for Partial Backups


MySQL Workbench
Local instance MySQL56
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
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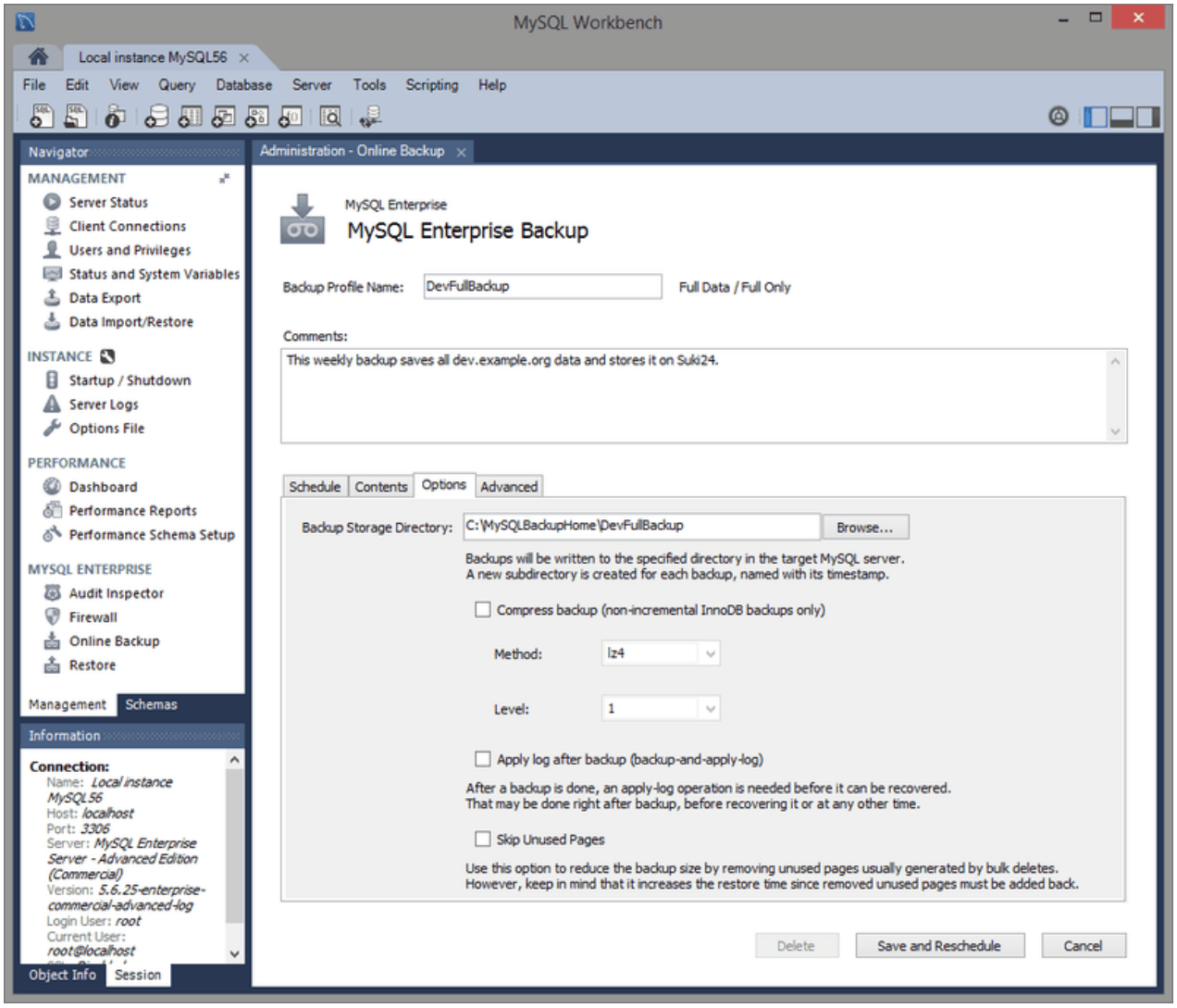
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
MYSQL ENTERPRISE
Audit Inspector
Firewall
Online Backup
Restore
Management Schemas
Information
Connection:
Name: Local instance MySQL56
Host: localhost
Port: 3306
Server: MySQL Enterprise Server - Advanced Edition (Commercial)
Version: 5.6.25-enterprise-commercial-advanced-log
Login User: root
Current User: root@localhost
SSL: Disabled
Object Info Session
Administration - Online Backup
MySQL Enterprise
MySQL Enterprise Backup
Backup Profile Name: PartialBackup
TTS Partial Data / Full Only
Comments:
This weekly backup saves all dev.example.org data and stores it on Suki24.
Schedule Contents Options Advanced
Backup full contents of this MySQL instance
Select objects to included/excluded
Select objects to be backed up (Legacy Options)
When these options are used the 'include' filter will be applied first creating the list of tables to be included.
The 'exclude' filter will be applied on the resulting table set.
Tables to Backup
Specify a regular expression to match all the tables to be included on the backup.
Any table db_name.table_name matching the regular expression will be included on the backup.
^sakila\.actor$
Tables to Exclude
Specify a regular expression to match all the tables to be excluded from the backup.
Any table db_name.table_name matching the regular expression will be excluded from the backup.
Transportable Tablespaces
Using transportable tablespaces allows restoring the backed up tables on a different server,
it also prevents the system tablespaces from being backed up saving space and IO resources.
This feature also has some limitations, please look at the MySQL Enterprise Backup Documentation for details.
Use Transportable Tablespaces: No
Delete
Save and Reschedule
Cancel

The **Options** tab includes settings to modify the default behavior of the backup process.

By default, the **Backup Storage Directory** is stored under a sub-folder using the name of the **Backup Profile Name** in the `MySQL Backup Home Directory` setting. Additional options include compression and `apply-log`, and the option to **Skip Unused Pages**.

Figure 6.36 Workbench: MySQL Enterprise Backup Configuration: Options


MySQL Workbench
Local instance MySQL56
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Restore
Management Schemas
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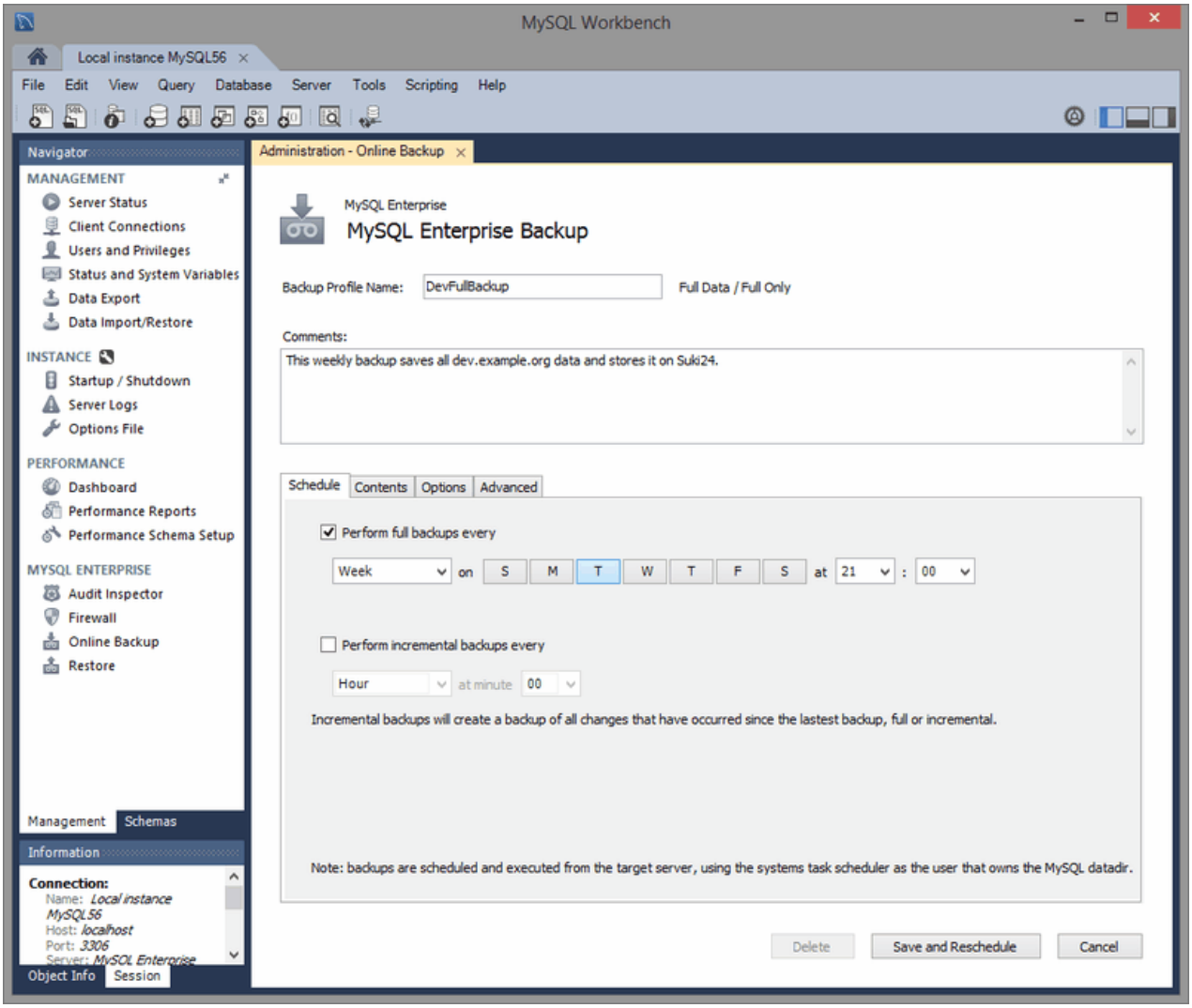
Connection:
Name: Local instance MySQL56
Host: localhost
Port: 3306
Server: MySQL Enterprise Server - Advanced Edition (Commercial)
Version: 5.6.25-enterprise-commercial-advanced-log
Login User: root
Current User: root@localhost
Object Info Session
Administration - Online Backup
MySQL Enterprise
MySQL Enterprise Backup
Backup Profile Name: DevFullBackup
Full Data / Full Only
Comments:
This weekly backup saves all dev.example.org data and stores it on Suki24.
Schedule Contents Options Advanced
Backup Storage Directory: C:\MySQLBackupHome\DevFullBackup
Browse...
Backups will be written to the specified directory in the target MySQL server.
A new subdirectory is created for each backup, named with its timestamp.
Compress backup (non-incremental InnoDB backups only)
Method: lz4
Level: 1
Apply log after backup (backup-and-apply-log)
After a backup is done, an apply-log operation is needed before it can be recovered.
That may be done right after backup, before recovering it or at any other time.
Skip Unused Pages
Use this option to reduce the backup size by removing unused pages usually generated by bulk deletes.
However, keep in mind that it increases the restore time since removed unused pages must be added back.
Delete
Save and Reschedule
Cancel

The **Schedule** tab optionally sets a backup schedule for both full and incremental backups. The schedule uses the Windows Tasks Scheduler on Microsoft Windows, and a cron job on Linux and OS X. It is scheduled using the operating system user that is scheduling the backup, which is typically the MySQL user.

A full backup is slower than the incremental backup that merges with a full backup. A common scenario is to set a full backup as weekly, and an incremental backup as daily. For additional information about backup performance, see Optimizing Backup Performance.

Figure 6.37 Workbench: MySQL Enterprise Backup Configuration: Schedule



The **Advanced** tab allows you to pass in additional MySQL Enterprise Backup options.

Note

These additional options are not validated.

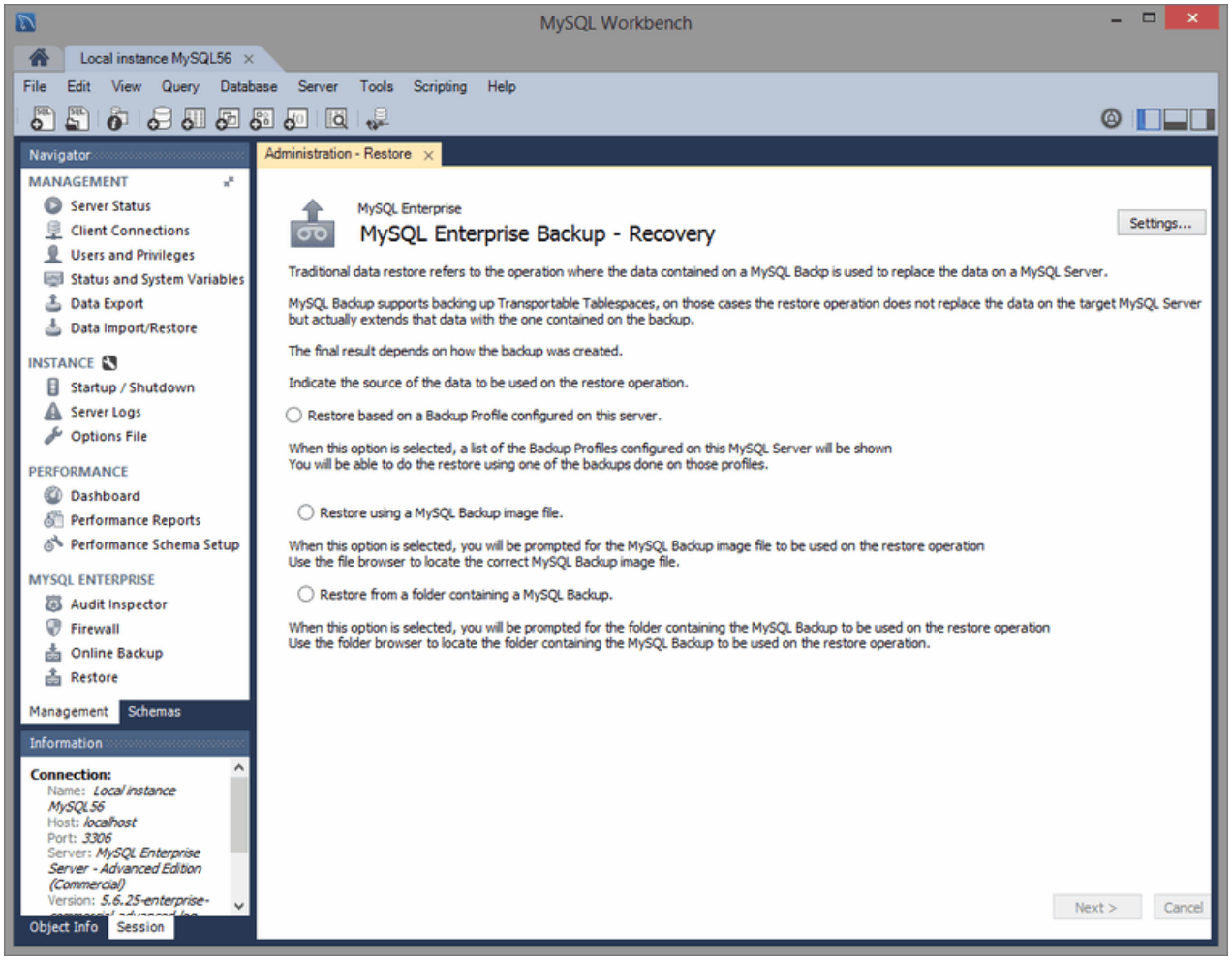
To recover backups, see Section 6.7.3, “Backup Recovery”.

6.7.3 Backup Recovery

The Backup Recovery wizard is used to recover MySQL Enterprise Backup backups. For more information about creating MySQL Enterprise Backup backups using MySQL Workbench, see Section 6.7.2, “Online Backup”

The Backup Recovery wizard allows you to restore backups from folders, image files, and backup profiles created by Section 6.7.2, “Online Backup”. Click **Restore** from the Navigator, then choose the appropriate option:

Figure 6.38 Workbench: Backup Recovery: Start


MySQL Workbench
Local instance MySQL56
File Edit View Query Database Server Tools Scripting Help
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MANAGEMENT
Server Status
Client Connections
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Data Export
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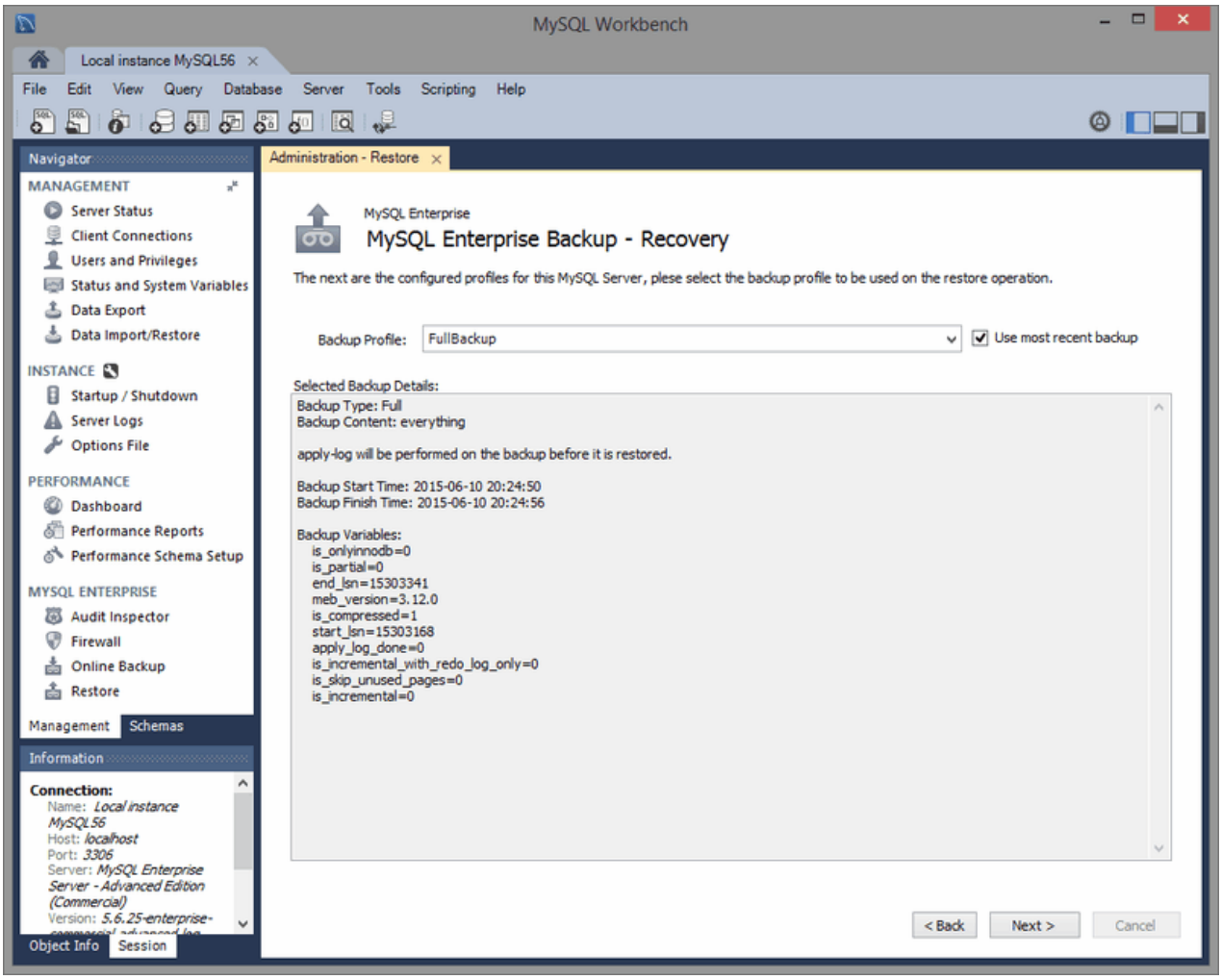
Audit Inspector
Firewall
Online Backup
Restore
Management Schemas
Information
Connection:
Name: Local instance MySQL56
Host: localhost
Port: 3306
Server: MySQL Enterprise Server - Advanced Edition (Commercial)
Version: 5.6.25-enterprise-
Object Info Session
Administration - Restore
MySQL Enterprise
MySQL Enterprise Backup - Recovery
Settings...
Traditional data restore refers to the operation where the data contained on a MySQL Backp is used to replace the data on a MySQL Server.
MySQL Backup supports backing up Transportable Tablespaces, on those cases the restore operation does not replace the data on the target MySQL Server but actually extends that data with the one contained on the backup.
The final result depends on how the backup was created.
Indicate the source of the data to be used on the restore operation.
Restore based on a Backup Profile configured on this server.
When this option is selected, a list of the Backup Profiles configured on this MySQL Server will be shown
You will be able to do the restore using one of the backups done on those profiles.
Restore using a MySQL Backup image file.
When this option is selected, you will be prompted for the MySQL Backup image file to be used on the restore operation
Use the file browser to locate the correct MySQL Backup image file.
Restore from a folder containing a MySQL Backup.
When this option is selected, you will be prompted for the folder containing the MySQL Backup to be used on the restore operation
Use the folder browser to locate the folder containing the MySQL Backup to be used on the restore operation.
Next >
Cancel

- **Backup Profile**: Choose from the available MySQL Enterprise Backup profiles on your system.
- **Backup Image File**: Opens the system's file browser; choose a backup image file to restore.
- **Backup Folder**: Opens the system's file browser; choose a backup folder to restore.

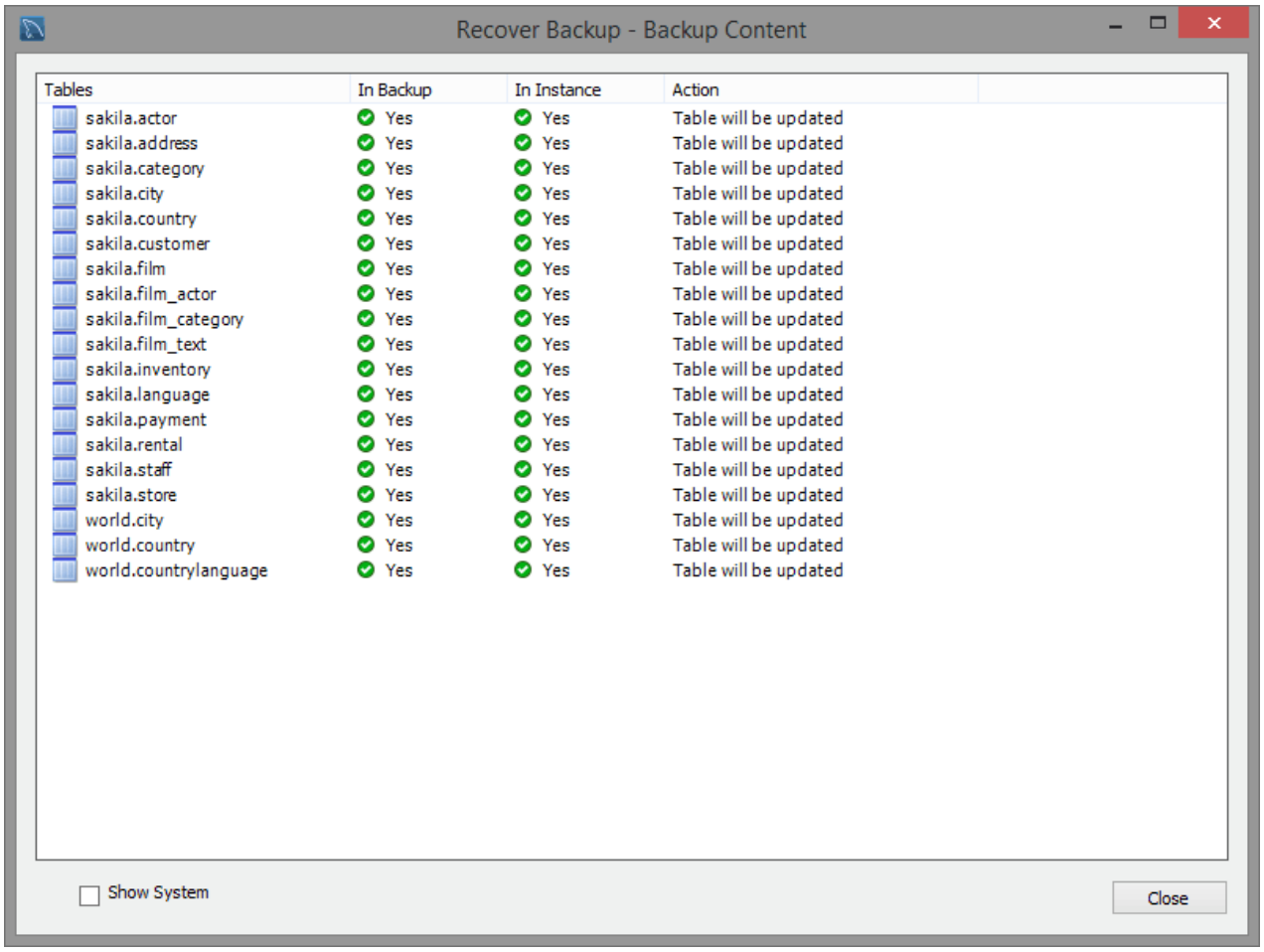
In our example, we will restore a full backup profile that was created by MySQL Workbench Online Backup. After choosing the "FullBackup" profile that we created earlier, use the next page to review its upcoming restoration:

Figure 6.39 Workbench: Backup Recovery: Profile



Optionally, click View Backup Content to view the backup contents for the restoration:

Figure 6.40 Workbench: Backup Recovery: Contents Table View

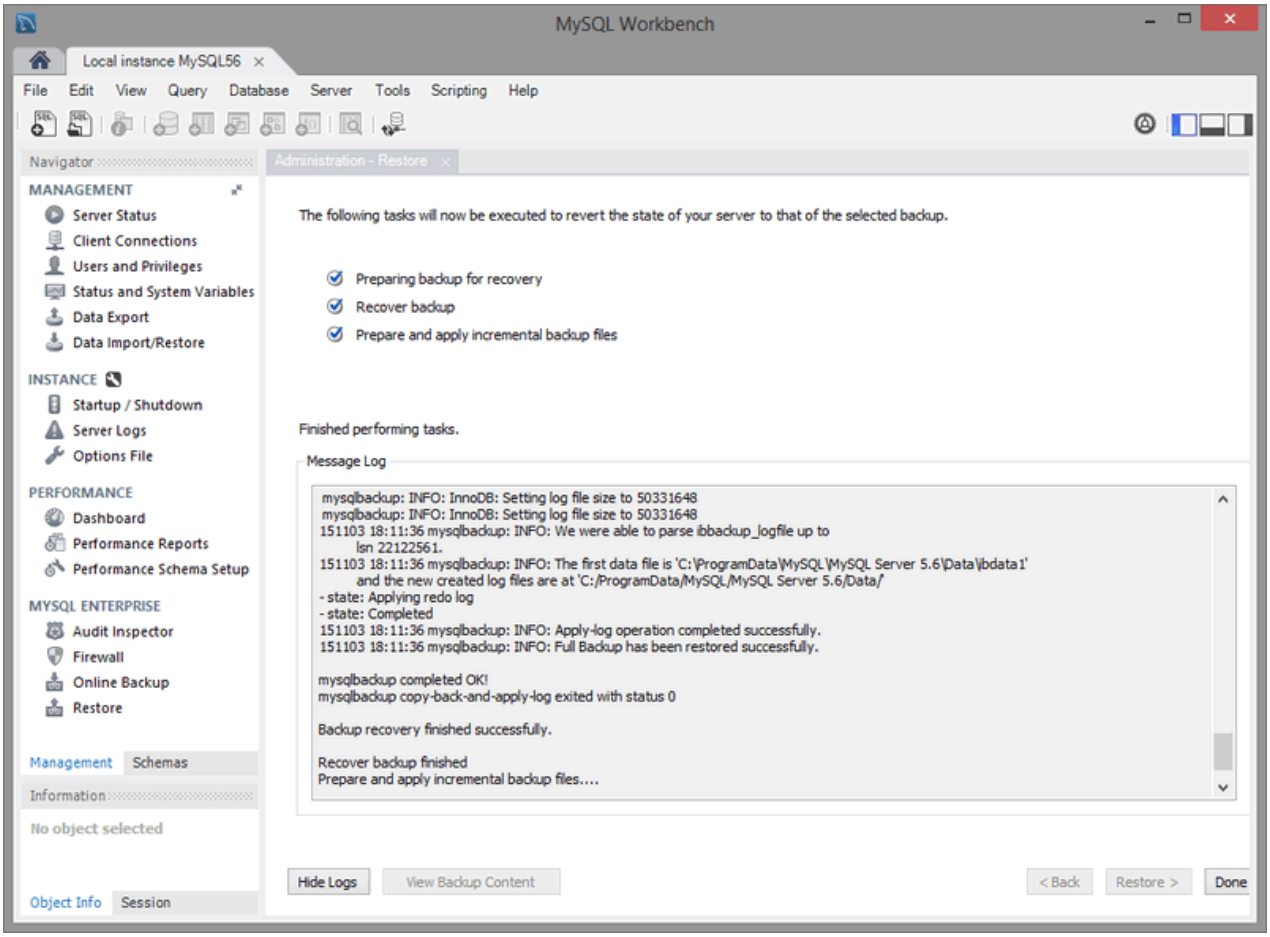

Recover Backup - Backup Content
Tables
In Backup
In Instance
Action
sakila.actor Yes Yes Table will be updated
sakila.address Yes Yes Table will be updated
sakila.category Yes Yes Table will be updated
sakila.city Yes Yes Table will be updated
sakila.country Yes Yes Table will be updated
sakila.customer Yes Yes Table will be updated
sakila.film Yes Yes Table will be updated
sakila.film_actor Yes Yes Table will be updated
sakila.film_category Yes Yes Table will be updated
sakila.film_text Yes Yes Table will be updated
sakila.inventory Yes Yes Table will be updated
sakila.language Yes Yes Table will be updated
sakila.payment Yes Yes Table will be updated
sakila.rental Yes Yes Table will be updated
sakila.staff Yes Yes Table will be updated
sakila.store Yes Yes Table will be updated
world.city Yes Yes Table will be updated
world.country Yes Yes Table will be updated
world.countrylanguage Yes Yes Table will be updated
Show System
Close

Note

The **Show System** checkbox toggles internal schemas from view, schemas such as the internal performance_schema and mysql tables.

Clicking Next > will open the **Restore** wizard. We then clicked Restore > to execute the restoration process, and toggled the message logs in our example below:

Figure 6.41 Workbench: Backup Recovery: Restore


MySQL Workbench
Local instance MySQL56
File Edit View Query Database Server Tools Scripting Help
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Dashboard
Performance Reports
Performance Schema Setup
MYSQL ENTERPRISE
Audit Inspector
Firewall
Online Backup
Restore
Management Schemas
Information
No object selected
Object Info Session
Administration - Restore
The following tasks will now be executed to revert the state of your server to that of the selected backup.
Preparing backup for recovery
Recover backup
Prepare and apply incremental backup files
Finished performing tasks.
Message Log
mysqlbackup: INFO: InnoDB: Setting log file size to 50331648
mysqlbackup: INFO: InnoDB: Setting log file size to 50331648
151103 18:11:36 mysqlbackup: INFO: We were able to parse ibbackup_logfile up to
lsn 22122561.
151103 18:11:36 mysqlbackup: INFO: The first data file is 'C:\ProgramData\MySQL\MySQL Server 5.6\data\ibdata1'
and the new created log files are at 'C:/ProgramData/MySQL/MySQL Server 5.6/Data/'
- state: Applying redo log
- state: Completed
151103 18:11:36 mysqlbackup: INFO: Apply-log operation completed successfully.
151103 18:11:36 mysqlbackup: INFO: Full Backup has been restored successfully.
mysqlbackup completed OK!
mysqlbackup copy-back-and-apply-log exited with status 0
Backup recovery finished successfully.
Recover backup finished
Prepare and apply incremental backup files....
Hide Logs
View Backup Content
< Back
Restore >
Done

6.8 MySQL Enterprise Firewall Interface

MySQL Workbench offers a GUI interface to MySQL Enterprise Firewall.

Note

The MySQL Enterprise Firewall interface was added in MySQL Workbench 6.3.4.

For additional information about MySQL Enterprise Firewall, see https://dev.mysql.com/doc/en/firewall.html.

Setup and Configuration

MySQL Workbench can manage the MySQL Enterprise Firewall installation and configuration by installing (or uninstalling) and enabling (or disabling) the plugin.

Note

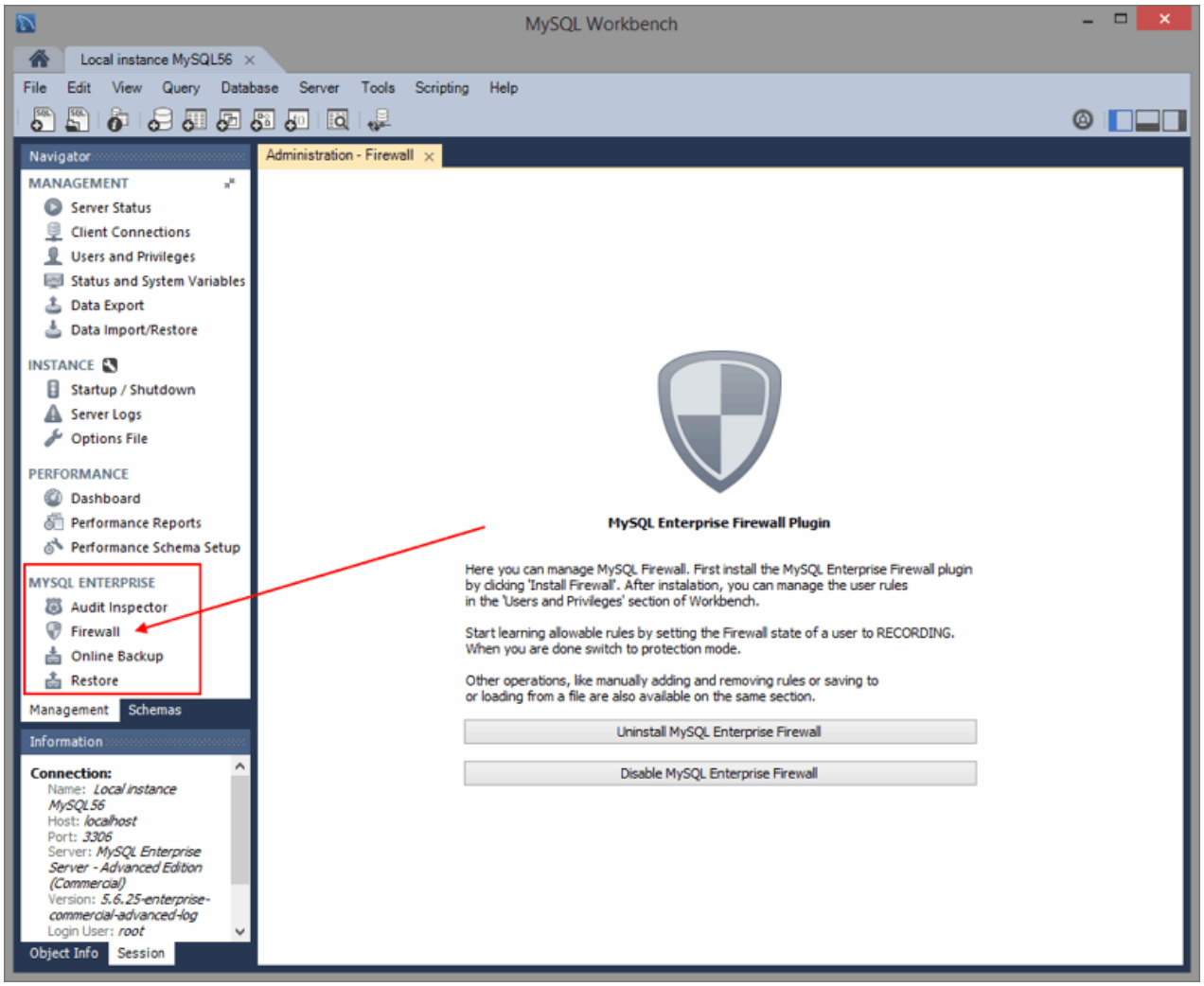
Alternatively, you can manually install and enable MySQL Enterprise Firewall. For additional information, see Installing or Uninstalling MySQL Enterprise Firewall.

- **Enable**: Executes *SET GLOBAL mysql_firewall_mode = ON;* against the connected MySQL server. **Disable** sets it to OFF instead of ON.

This is a runtime operation. Configure the MySQL server configuration file to enable MySQL Enterprise Firewall at startup.

- **Install**: Executes queries to install the new MySQL Enterprise Firewall tables and stored procedure needed to switch the state. **Uninstall** reverses these effects, which also removes the recorded rules.

Figure 6.42 MySQL Enterprise Firewall Installation and Configuration


MySQL Workbench
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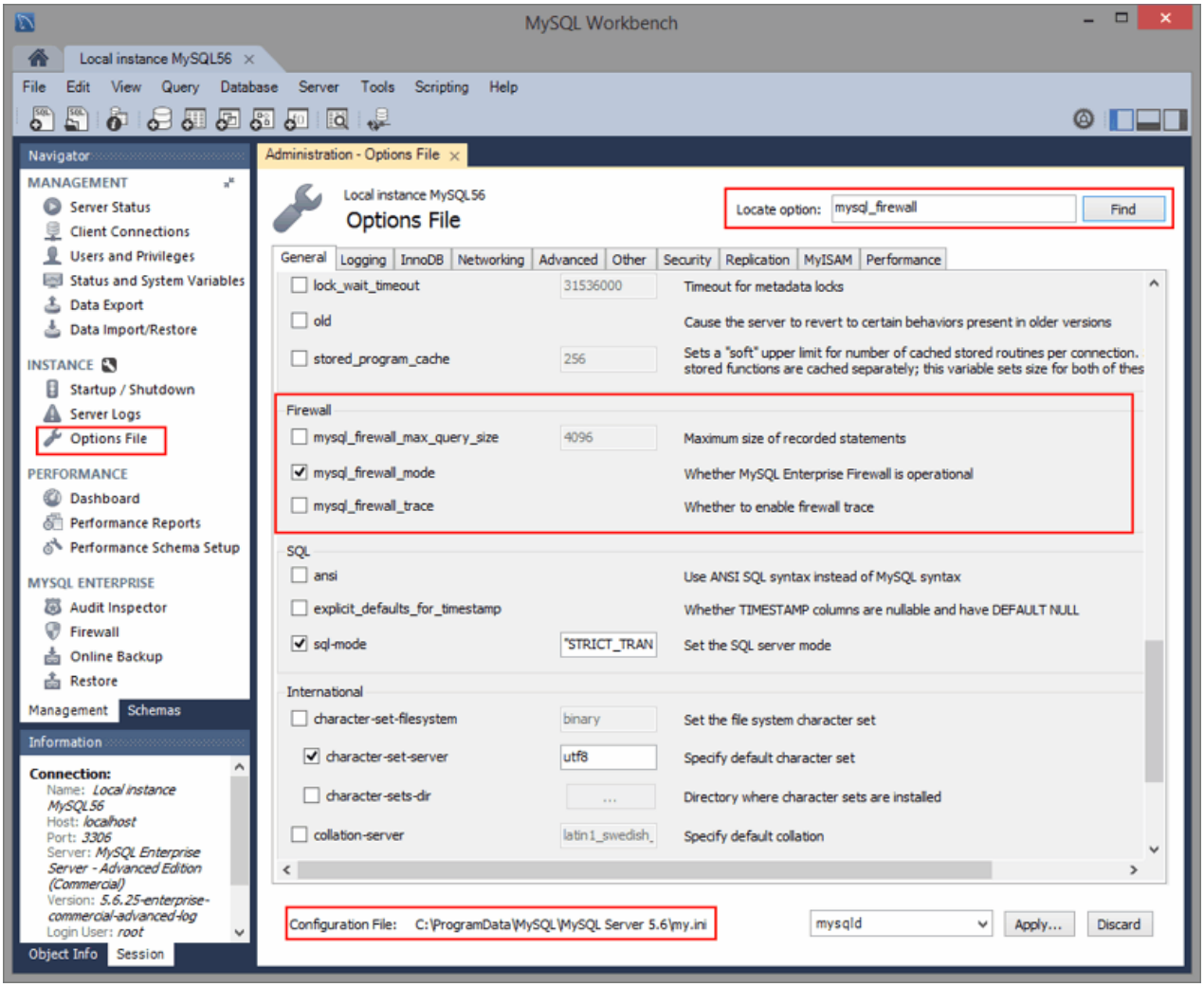
Audit Inspector
Firewall
Online Backup
Restore
Management
Schemas
Information
Connection:
Name: Local instance MySQL56
Host: localhost
Port: 3306
Server: MySQL Enterprise Server - Advanced Edition (Commercial)
Version: 5.6.25-enterprise-commercial-advanced-log
Login User: root
Object Info
Session
Administration - Firewall
MySQL Enterprise Firewall Plugin
Here you can manage MySQL Firewall. First install the MySQL Enterprise Firewall plugin by clicking 'Install Firewall'. After instalation, you can manage the user rules in the 'Users and Privileges' section of Workbench.
Start learning allowable rules by setting the Firewall state of a user to RECORDING. When you are done switch to protection mode.
Other operations, like manually adding and removing rules or saving to or loading from a file are also available on the same section.
Uninstall MySQL Enterprise Firewall
Disable MySQL Enterprise Firewall

Because clicking Enable Firewall from MySQL Workbench is a runtime operation, enabling the `mysql_firewall_mode` option in the configuration option will enable it after a restart. Manually edit the MySQL configuration file, or use MySQL Workbench to edit it.

Figure 6.43 Edit MySQL Enterprise Firewall Options Using Workbench



Firewall Rules and Information

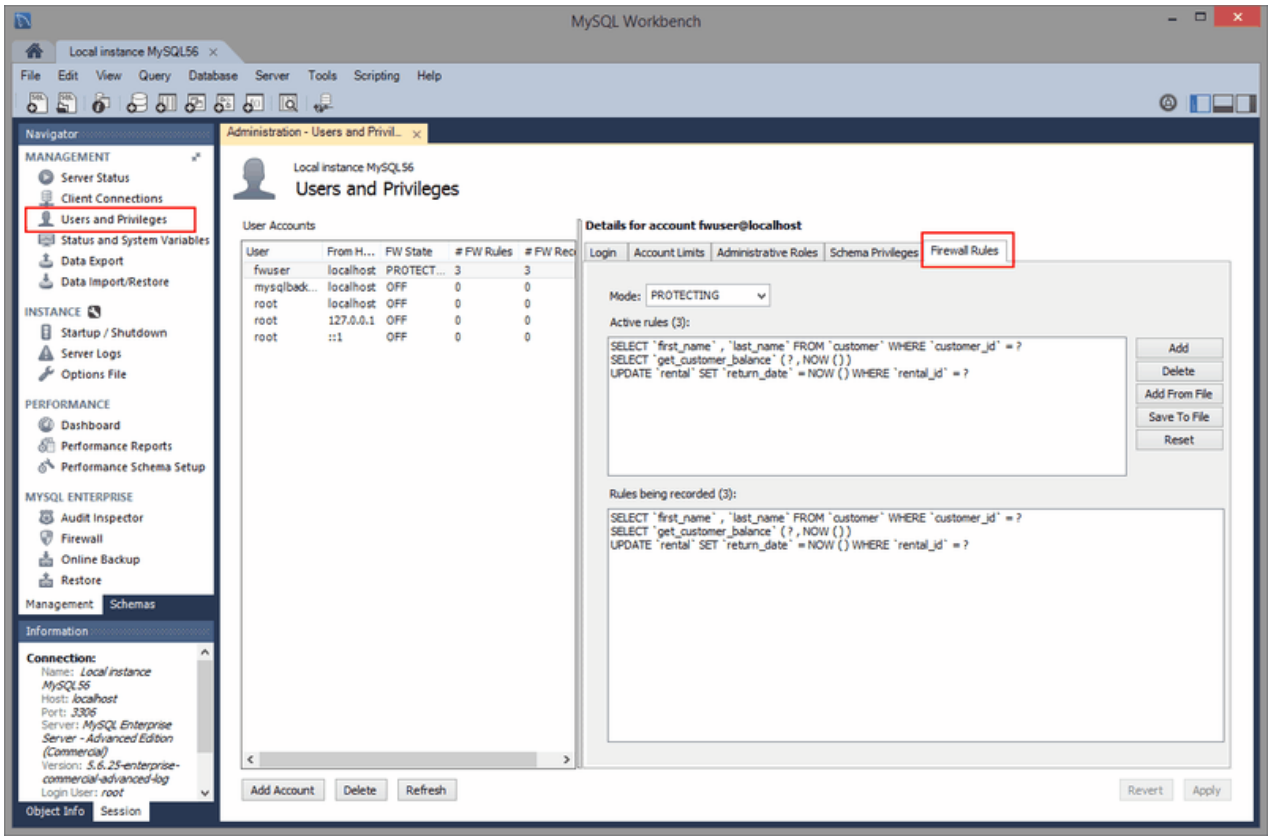
The **Firewall Rules** tab lists the active and recorded rules for a given user, the state of each rule, and includes options to add, delete, and save rules.

- **State** (mode): Options include **OFF** (disables the firewall), **PROTECTING** (enables the whitelist), **RECORDING** (training mode), and **RESET** (removes the rules). For additional information about the meaning of these states, see MySQL Enterprise Firewall Procedures and Functions.
- Administrative actions include Add and Delete for individual rules, and Clear to clear (remove) all rules. Add From File prompts for a firewall rules text file (defaults to the `.fwr` extension) that contains one rule per line, and Save To File saves the current rules.
- *Active rules* are used in PROTECTIVE mode, and *Rules being recorded* are entries still being RECORDED. Switching from RECORDING to PROTECTING mode copies the recorded rules into the active rule subset.

Note

MySQL Workbench executes queries, gets variables, and performs a lot of checks. For this reason, MySQL Workbench is more useful as an administration tool for MySQL Enterprise Firewall than a tool to record rules. For example, RECORDING rules in MySQL Workbench will record the behind-the-scenes operations performed by MySQL Workbench for the MySQL user. Also, using MySQL Workbench by a MySQL user in PROTECTING mode will attempt to execute operations that a typical firewalled MySQL user might not have access to.

Figure 6.44 MySQL Enterprise Firewall Rules



6.9 The wbcopytables Tool

`wbcopytables` is a command line utility included in MySQL Workbench that allows you to copy table data from a supported source database server to MySQL. It is used by the Workbench Migration wizard to copy data after the schema is migrated and created in the target MySQL server.

`wbcopytables` can connect to the source database using either ODBC, the Python DBAPI, or the native MySQL client library.

The copy executes a `SELECT` statement on the source database, and then `INSERT`'s the retrieved rows into the target MySQL server.

Table 6.2 File Location (Default)

Operating System	Location
Linux	`/usr/bin/wbcopytables`

Operating System	Location
OS X	`/Applications/MySQLWorkbench.app/Contents/MacOS/wbcopytables`
Windows	`C:\Program Files (x86)\MySQL\MySQL Workbench 6.3\wbcopytables.exe`

Connection Parameters

Options for the source connection are:

`--odbc-source`=*`ODBC_connection_string`*: The syntax of the ODBC connection string uses standard ODBC syntax. You can also use a ODBC data source name (DSN).

`--mysql-source`=*`MySQL_connection_string`*: Use for MySQL sources (when doing a MySQL to MySQL migration/copy). It uses the same syntax as the MySQL Utilities:

- For TCP/IP connections: *`username[:password]@host:port`*
- For local socket connections: *`username[:password]@::socket_path`*

You can pass the connection password by using the `--source-password` option.

For the target connection, the option is: `--target`=*`MySQL_connection_string`*.

You can use the `--passwords-from-stdin` option to pass a passwords through STDIN. Source and target passwords must be separated by a tab character.

You can use ODBC specific data source options from the source RDBMS to specify the number of rows to fetch at a time for the source `SELECT` statement.

Table Specification

One or more tables can be specified in the command line for the copy operation. There are two copy types:

- Full table copy: `--table`
- Range copy: `--table-range`

Both table copy types require a set of common arguments:

- **Source schema**: The schema/catalog the table belongs to. If quoting is required, it must be done using the syntax from the source RDBMS. For example, SQL Server uses *[square_brackets]*.
- **Source table**: The table to copy. If the source RDBMS uses a schema name in addition to a catalog, both schema and table must be specified here and separated by a dot. For example, *[dbo].[mytable]*.
- **Target schema**: The name of the MySQL schema. If quoting is needed, it must use the MySQL backtick syntax. For example, `` `sakila` ``.
- **Target table**: The name of the MySQL table.
- **Select expression**: The list of fields to `SELECT`. This will be inserted verbatim into the source `SELECT` statement.

Caution

Use caution as this expression is copied directly into the source `SELECT` statement.

For the select expression, if both the source and target tables have the same fields in the same order, and use compatible types, you can simply pass `*` here, which will build a query like "*SELECT * FROM [dbo].[mytable]*". If not, you can specify the fields as you would in the `SELECT` statement, which are comma (,) separated and with proper escaping/quoting specific to the source RDBMS. You can also specify typecasts and/or data conversions that the source RDBMS supports. For example:

[client_id], [name], [address], AsText([location])

Because each option must be interpreted as a single option by the `wbcopytables` command, you must perform OS shell specific quoting whenever necessary. Usually, quoting your parameter values with 'single' or "double" quotes is enough. This is in addition to any database specific quoting you use.

Full Table Copy

This performs a full `SELECT` on the source table, fetches records, and then inserts them into the target table.

There are no additional arguments required.

The `--table` syntax is as follows:

```
--table Source_Schema Source_Table Target_Schema Target_Table Select_Expression
```

Range Copy

This performs a `SELECT` copy on the source table for the specified range. The table must have a numeric `UNIQUE NOT NULL` or `PRIMARY KEY` that is used to create a `WHERE` expression for the range.

The `--table-range` syntax is as follows:

```
--table-range Source_Schema Source_Table Target_Schema Target_Table Select_Expression Source_Key Range_Start R
```

The generated expression is:

```
key_column >= range_start AND key_column <= range_end
```

If you specify **-1** for Range_End, then the expression will be:

```
key_column >= range_start
```

Other Options

- `--thread-count`=*`Number`*: If you are copying more than one table, you can use this option to divide the tables across several threads. There is no support for dividing a single table across many threads.
- `--count-only`: Only perform a `COUNT(*)` of the `SELECT` which would be generated by the `--table` option that was used. The target schema and table can be omitted in this case.

- `--truncate-target`: Execute a TRUNCATE TABLE command on each target table that is copied.

Trigger Handling

Because there is no way to temporarily disable triggers in MySQL and they can affect the copy process, MySQL Workbench will backup and drop all triggers from the target MySQL database before the copy process starts, and then these triggers are restored after the copy finishes. The triggers are backed up in the target schema under a table named `wb_tmp_triggers`.

- `--disable-triggers-on`=*`Schema_Name`*: Performs the backup and DROP process for all triggers in the specified schema.
- `--reenable-triggers-on`=*`Schema_Name`*: Restores triggers previously backed up to the `wb_tmp_triggers` table.
- `--dont-disable-triggers`: Bypass the trigger disabling step.

Chapter 7 Performance Tools

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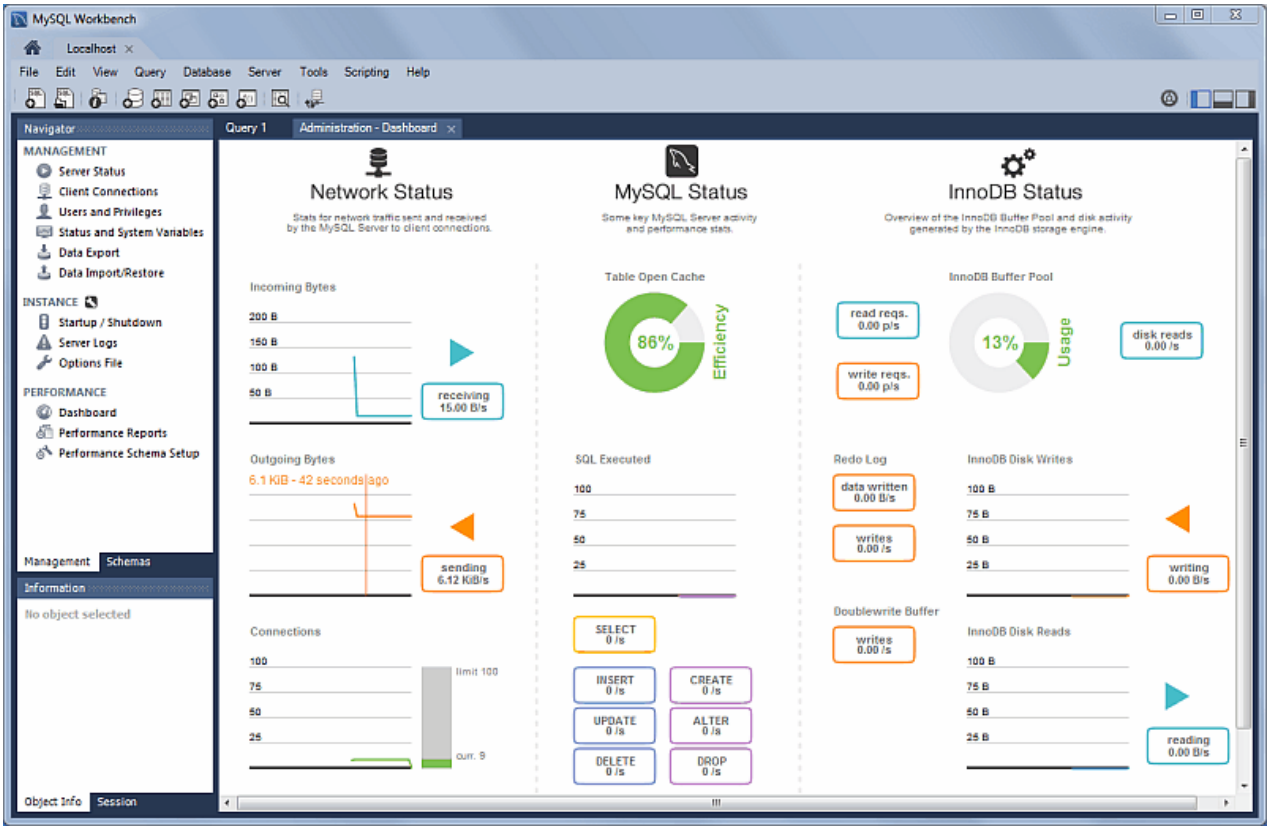
7.1 Performance Dashboard

View server performance statistics in a graphical dashboard.

Figure 7.1 Performance: Dashboard



Network Status

This highlights statistics for network traffic sent and received by the MySQL server over client connections. Data points include the **Incoming Network Traffic**, **Outgoing Network Traffic**, and **Client Connections**.

MySQL Status

This highlights the primary MySQL server activity and performance statistics. Data points include the **Table Open Cache** efficiency, **SQL Statements Executed**, and counts (per second) for SELECT, INSERT, UPDATE, DELETE, CREATE, ALTER, and DROP statements.

InnoDB Status

This provides an overview of the InnoDB Buffer Pool and disk activity that is generated by the InnoDB storage engine. Data points are separated into three groups:

Note

Hover over a graph to see additional information, such as a total count.

- **Usage**
  - *Read Requests*: The number of logical read requests (per second) InnoDB has performed to the buffer pool.
  - *Write Requests*: The number of logical write requests (per second) InnoDB has performed to the buffer pool.
  - *Disk Reads*: The number of logical reads that InnoDB could not satisfy from the buffer pool. As a result, these had to be read from the disk.
  - *InnoDB Buffer Pool Usage*: The percentage of the InnoDB buffer pool that is in use. Hover over the graphic to see additional information, such as Usage Rate and Pages Free.
- **Writes**
  - *Data Written*: The number of writes written to the InnoDB redo log file.
  - *Writes*: The number of physical writes written to the InnoDB redo log file.
  - *InnoDB Disk Writes*: Hover over this dynamic graph to see the number of disk writes over a specific second. The available range includes the last 120 seconds.
  - *Writing*: Total amount of data (in bytes) written using file operations by the InnoDB storage engine.
- **Reads**
  - *Doublewrite Buffer Writes*: The number of doublewrite operations that were performed.
  - *InnoDB Disk Reads*: Hover over this dynamic graph to see the number of disk reads over a specific second. The available range includes the last 120 seconds.
  - *Reading*: Total amount of data (in bytes) read in file operations by the InnoDB storage engine.

7.2 Performance Schema Reports

Performance schema based reports provide insight into the MySQL server operations through helpful high-level reports. MySQL Workbench uses the **SYS** views on the Performance Schema to generate over 20 reports to help analyze the performance of your MySQL databases. Reports help analyze IO hotspots, discover high cost SQL statements, and review wait statistics and InnoDB engine metrics. For additional information about the SYS schema, see MySQL sys Schema.

Installation and Configuration

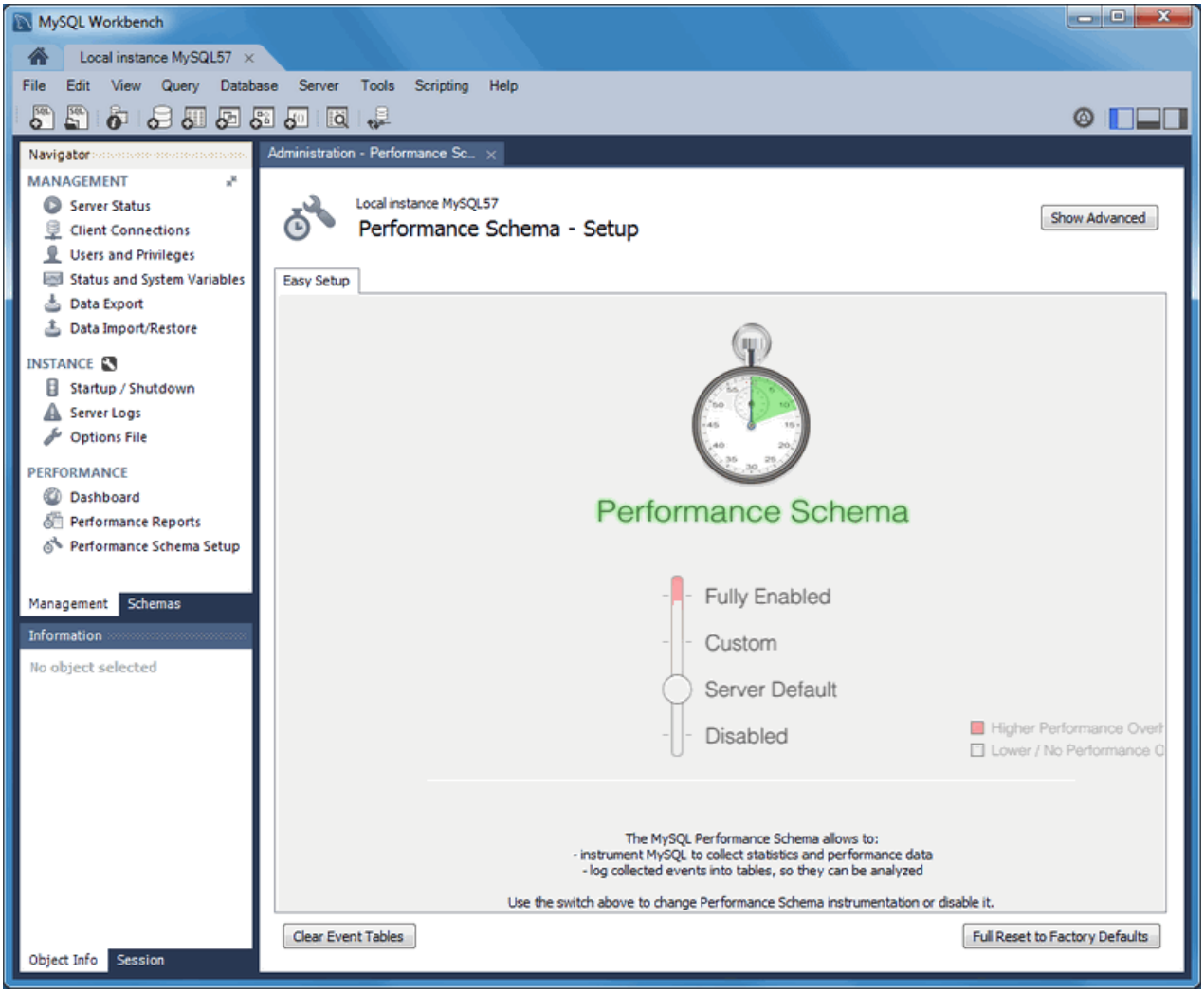
A GUI for configuring and fine tuning the Performance Schema instrumentation. Initially, this loads an "Easy Setup" page that is enough for most users. Slide the "Performance Schema Full Enabled" slider to **YES** to enable all available Performance Schema instruments.

The SYS schema is bundled with MySQL Server 5.7 and above, and MySQL Workbench uses that version. However, for MySQL Server 5.6, Workbench installs its own bundled version of the SYS schema.

Note

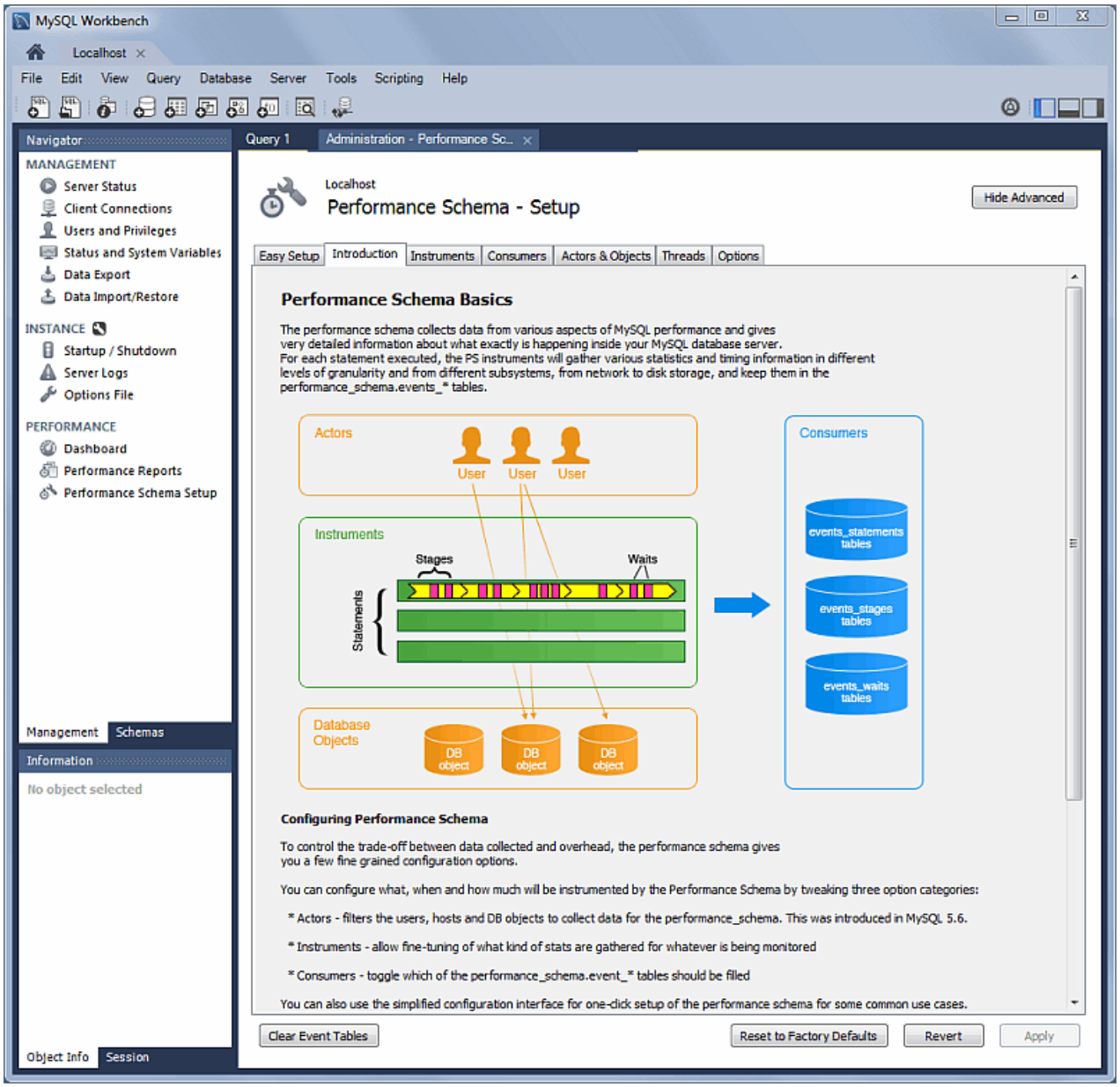
The size of the saved digested query is determined by the MySQL server.

Figure 7.2 Performance Schema Setup: Easy Setup



Clicking Show Advanced provides methods to fine tune the Performance Schema instrumentation.

Figure 7.3 Performance Schema Setup: Introduction


MySQL Workbench
Localhost
File Edit View Query Database Server Tools Scripting Help
Navigator
MANAGEMENT
Server Status
Client Connections
Users and Privileges
Status and System Variables
Data Export
Data Import/Restore
INSTANCE
Startup / Shutdown
Server Logs
Options File
PERFORMANCE
Dashboard
Performance Reports
Performance Schema Setup
Management Schemas
Information
No object selected
Object Info Session
Query 1
Administration - Performance Sc...
Localhost
Performance Schema - Setup
Hide Advanced
Easy Setup Introduction Instruments Consumers Actors & Objects Threads Options
Performance Schema Basics
The performance schema collects data from various aspects of MySQL performance and gives very detailed information about what exactly is happening inside your MySQL database server. For each statement executed, the PS instruments will gather various statistics and timing information in different levels of granularity and from different subsystems, from network to disk storage, and keep them in the performance_schema.events_* tables.
Actors
User User User
Instruments
Stages
Waits
Statements
Database Objects
DB object DB object DB object
Consumers
events_statements tables
events_stages tables
events_waits tables
Configuring Performance Schema
To control the trade-off between data collected and overhead, the performance schema gives you a few fine grained configuration options.
You can configure what, when and how much will be instrumented by the Performance Schema by tweaking three option categories:
* Actors - filters the users, hosts and DB objects to collect data for the performance_schema. This was introduced in MySQL 5.6.
* Instruments - allow fine-tuning of what kind of stats are gathered for whatever is being monitored
* Consumers - toggle which of the performance_schema.event_* tables should be filled
You can also use the simplified configuration interface for one-click setup of the performance schema for some common use cases.
Clear Event Tables
Reset to Factory Defaults
Revert
Apply

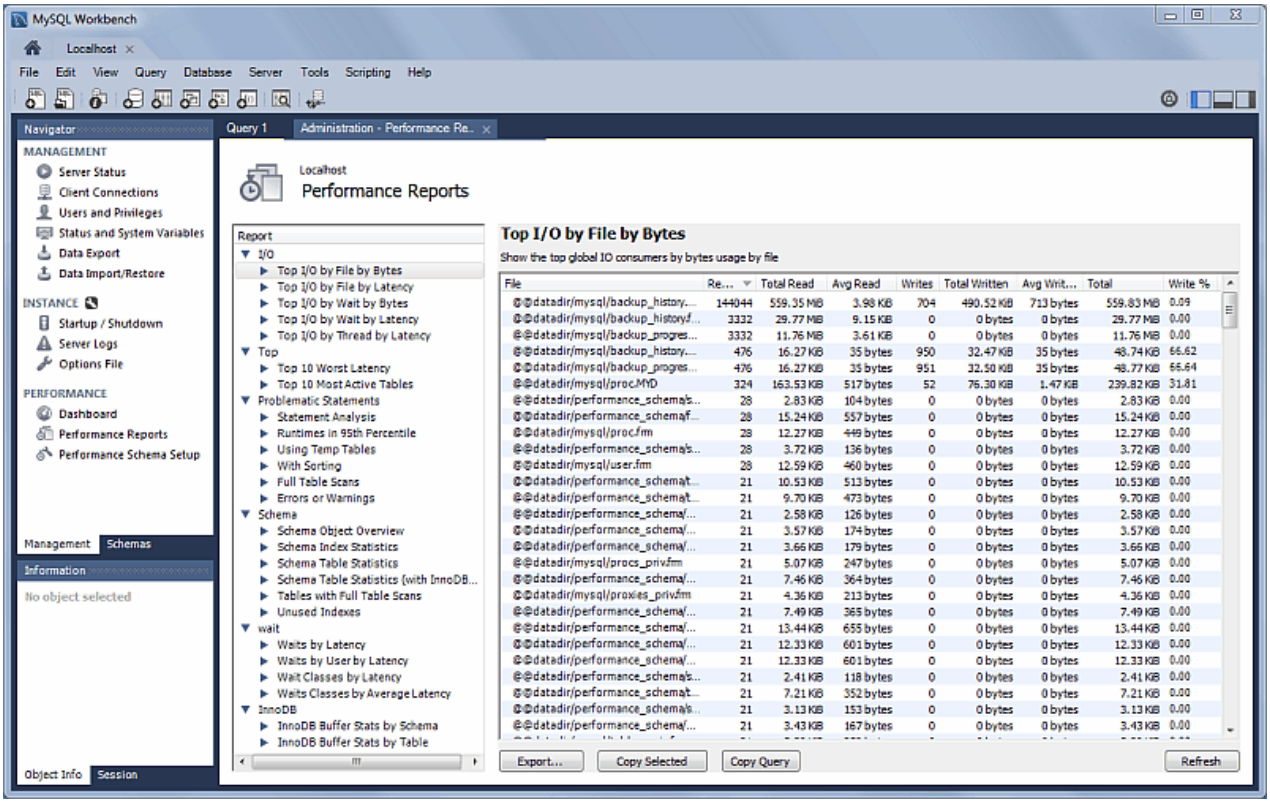
Performance Report Controls

Performance report data can be viewed and exported using the following controls:

- Export: Export all entries and associated data (and column headings) from the current performance report, which includes all queries and values. Opens a file dialog for export.
- Copy Selected: Copies a single entry and associated data (and column headings) from the current performance report. Saves to the system's clipboard. An example:
- Copy Query: Copies the SQL query that generated the performance report. Saves to the system's clipboard.
- Refresh: Refreshes (reloads) the performance report.

Performance Report Descriptions

Figure 7.4 Performance Reports: Top I/0 By Bytes



The available performance reports include (this is a non-exhaustive list):

- *Top File I/O Activity Report*: Show the files performing the most IOs (in bytes)
- *Top I/O by File by Time*: Show the highest IO usage by file and latency
- *Top I/O by Event Category*: Show the highest IO Data usage by event categories
- *Top I/O in Time by Event Categories*: Show the highest IO time consumers by event categories
- *Top I/O Time by User/Thread*: Show the top IO time consumers by user/thread
- *Statement Analysis*: Lists statements with aggregated statistics
- *Statements in Highest 5 Percent by Runtime*: Lists the top 5% statements with the highest runtime (in microseconds),
- *Using Temp Tables*: Lists all statements that use temporary tables -- accesses the highest number of disk temporary tables, then memory temp tables
- *With Sorting*: List all normalized statements that have done sorts, and accesses them in the following priority order -- sort_merge_passes, sort_scans, then sort_rows
- *Full Table Scans*: Lists statements that performed a full table scan. Accesses query performance and the where clause(s), and if no index is used then it recommends adding indexes for large tables
- *Errors or Warnings*: Lists statements that have raised errors or warnings

- *Schema Object Overview (High Overhead)*: Shows counts by object type for each schema

Note

This can take a long time to execute on instances with a large number of objects.

- *Schema Index Statistics*
- *Schema Table Statistics*
- *Schema Table Statistics (with InnoDB buffer)*
- *Tables with Full Table Scans*: Finds tables that are being accessed by full table scans, ordering them by the number of rows scanned (DESC)
- *Unused Indexes*: List of indexes that were never used since the server started or since P_S data collection started
- *Waits by Time*: Lists the top wait events by their total time, ignoring idle (this often contain large values)
- *Waits by User by Time*: Lists the top wait events by their total time, ignoring idle (this often contain large values)
- *Wait Classes by Time*: Lists the top wait classes by total time, ignoring idle (this often contain large values)
- *Waits Classes by Average Time*: Lists the top wait classes by average time, ignoring idle (this often contain large values)
- *InnoDB Buffer Stats by Schema*: Summarizes the output of the `INFORMATION_SCHEMA.INNODB_BUFFER_PAGE` table, aggregating it by schema
- *InnoDB Buffer Stats by Table*: Summarizes the output of the `INFORMATION_SCHEMA.INNODB_BUFFER_PAGE` table, aggregating it by schema and table name

7.3 Visual Explain Plan

The **Visual Explain** feature generates and displays a visual representation of the MySQL `EXPLAIN` statement by using extended information available in the extended JSON format.

Note

The extended EXPLAIN format is available as of MySQL server 5.6.5.

MySQL Workbench provides all of the EXPLAIN formats for executed queries including the raw extended JSON, traditional format, and visual query plan.

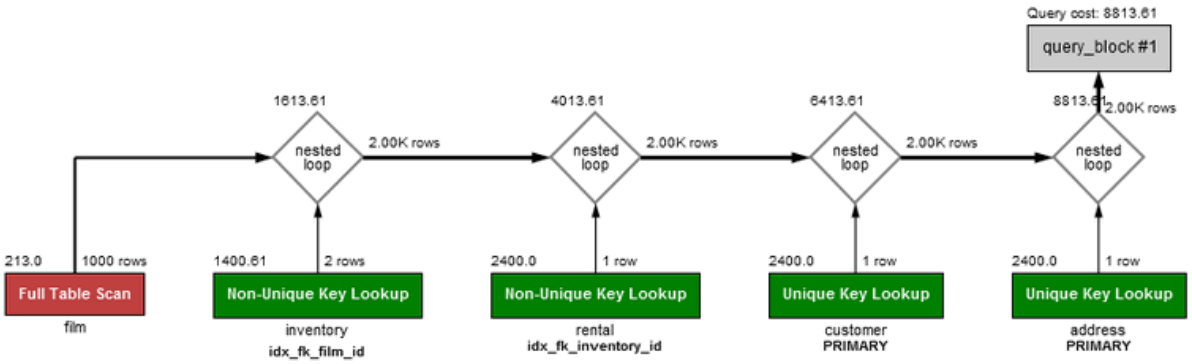
Visual Explain Conventions

An example Visual Explain diagram:

```
SELECT CONCAT(customer.last_name, ', ', customer.first_name) AS customer, address.phone, film.title
FROM rental
INNER JOIN customer ON rental.customer_id = customer.customer_id
INNER JOIN address ON customer.address_id = address.address_id
INNER JOIN inventory ON rental.inventory_id = inventory.inventory_id
```

```
INNER JOIN film ON inventory.film_id = film.film_id
WHERE rental.return_date IS NULL
AND rental_date + INTERVAL film.rental_duration DAY < CURRENT_DATE()
LIMIT 5;
```

Figure 7.5 A Visual Explain Example



The order of execution is bottom to top, and left to right.

Graphic Conventions

- Standard Boxes: tables
- Rounded boxes: operations such as GROUP and SORT
- Framed boxes: subqueries
- Diamonds: joins

Textual Conventions

- Standard text below boxes: table (or alias) name
- Bold text below boxes: key/index that was used
- Number in top right of a box: number of rows used from the table after filtering
- Number in top left of a box: relative cost of accessing that table (requires MySQL 5.7 or greater)
- Number to the right of nested loop diamonds: number of rows produced by the JOIN
- Number above the loop diamonds: relative cost of the JOIN (requires MySQL 5.7 or greater)

The associated colors and descriptions used in the Visual Explain diagram:

Table 7.1 Visual Explain Diagram Information

System Name	Color	Text on Visual Diagram	Tooltip related information
SYSTEM	Blue	Single row: system constant	Very low cost

System Name	Color	Text on Visual Diagram	Tooltip related information
CONST	Blue	Single row: constant	Very low cost
EQ_REF	Green	Unique Key Lookup	Low cost -- The optimizer is able to find an index that it can use to retrieve the required records. It is fast because the index search directly leads to the page with all the row data
REF	Green	Non-Unique Key Lookup	Low-medium -- Low if the number of matching rows is small; higher as the number of rows increases
FULLTEXT	Yellow	Fulltext Index Search	Specialized FULLTEXT search. Low -- for this specialized search requirement
REF_OR_NULL	Green	Key Lookup + Fetch NULL Values	Low-medium -- if the number of matching rows is small; higher as the number of rows increases
INDEX_MERGE	Green	Index Merge	Medium -- look for a better index selection in the query to improve performance
UNIQUE_SUBQUERY	Orange	Unique Key Lookup into table of subquery	Low -- Used for efficient Subquery processing
INDEX_SUBQUERY	Orange	Non-Unique Key Lookup into table of subquery	Low -- Used for efficient Subquery processing
RANGE	Orange	Index Range Scan	Medium -- partial index scan
INDEX	Red	Full Index Scan	High -- especially for large indexes
ALL	Red	Full Table Scan	Very High -- very costly for large tables, but less of an impact for small ones. No usable indexes were found for the table, which forces the optimizer to search every row. This could also mean that the search range is so broad that the index would be useless.
UNKNOWN	Black	unknown	Note: This is the default, in case a match cannot be determined

Visual Explain Usage

To view a visual explain execution plan, execute your query from the SQL editor and then choose the **Execution Plan** tab in the query results tab. The execution plan defaults to "Visual Explain" but also has a "Tabular Explain" view that is similar to what you would see when executing EXPLAIN in the MySQL client.

7.4 Query Statistics

This **Query Stats** SQL editor results tab uses Performance Schema data to gather key statistics collected for executed query, such as timing, temporary tables, indexes, joins, and more.

Requirements

- MySQL server 5.6 or newer

- Query, Collect Performance Schema Stats enabled.
- The `performance_schema` enabled with statement instrumentation

Figure 7.6 SQL Editor: Query Stats

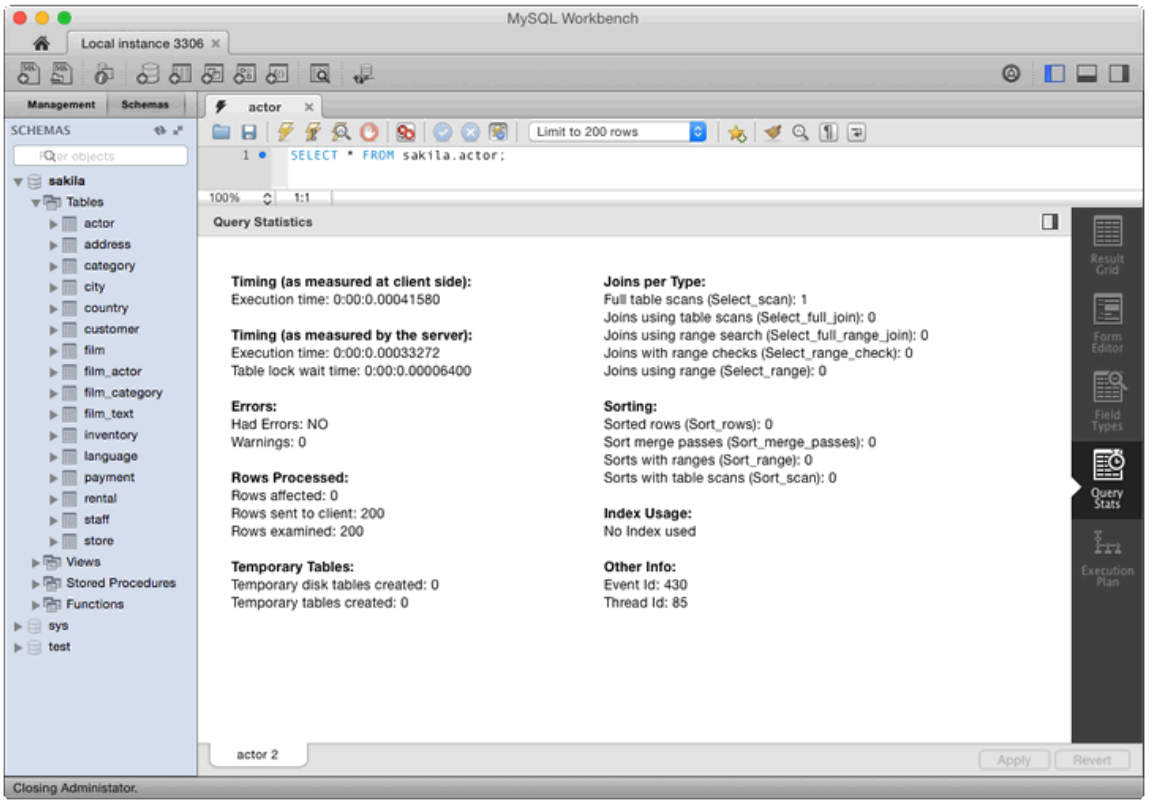
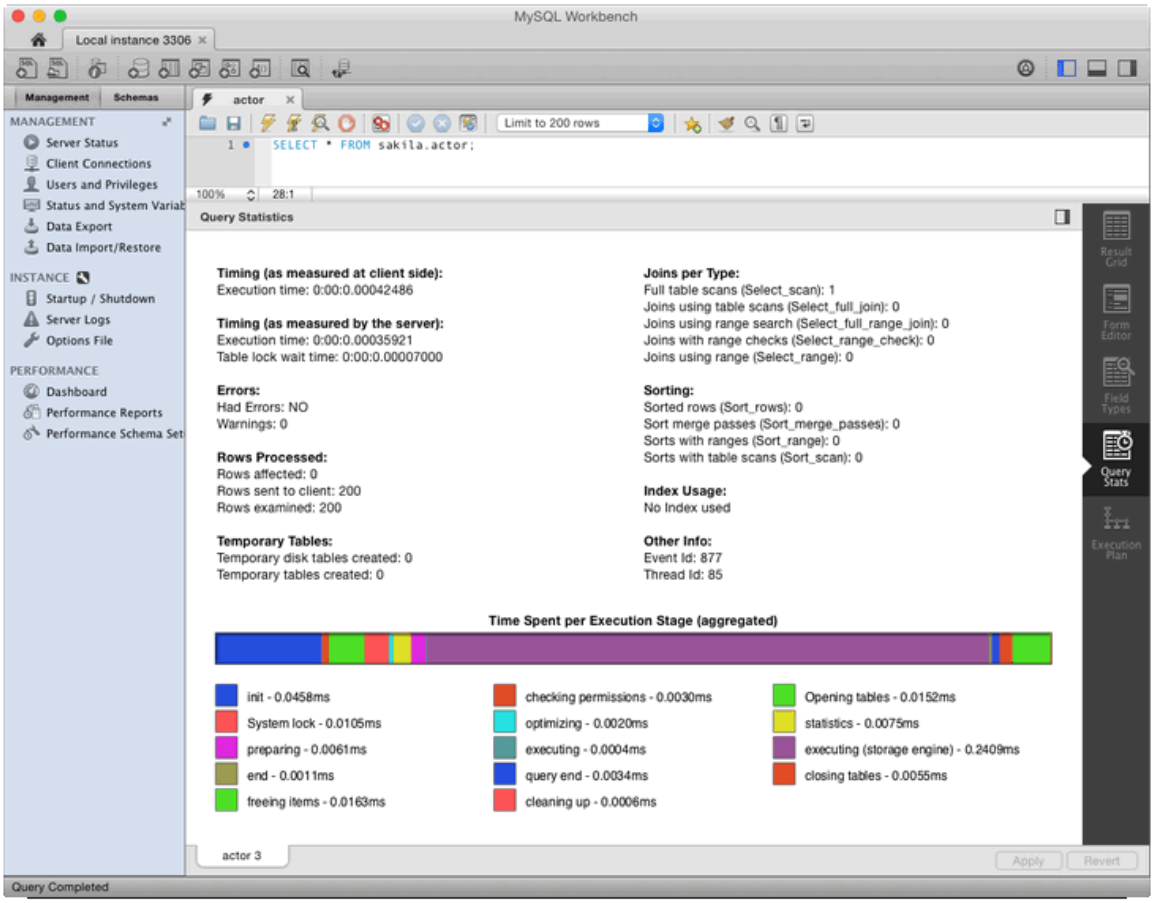


Figure 7.7 SQL Editor: Query Stats with Performance Schema Graphs



7.5 Tutorial: Using Visual Explain to improve query performance

In this example, Visual Explain helps locate and fix problematic (slow) queries. This tutorial uses the DBT-3 database, and begins with the following query:

```
SELECT * FROM orders
WHERE YEAR(o_orderdate) = 1992 AND MONTH(o_orderdate) = 4
AND o_clerk LIKE '%0223';
```

In the screenshot below, we executed this query and generated a Visual Explain report by selecting Query, Visual Explain Current Statement from the main menu.

Figure 7.8 DBT-3 Visual Explain Tutorial: Full Table Scan

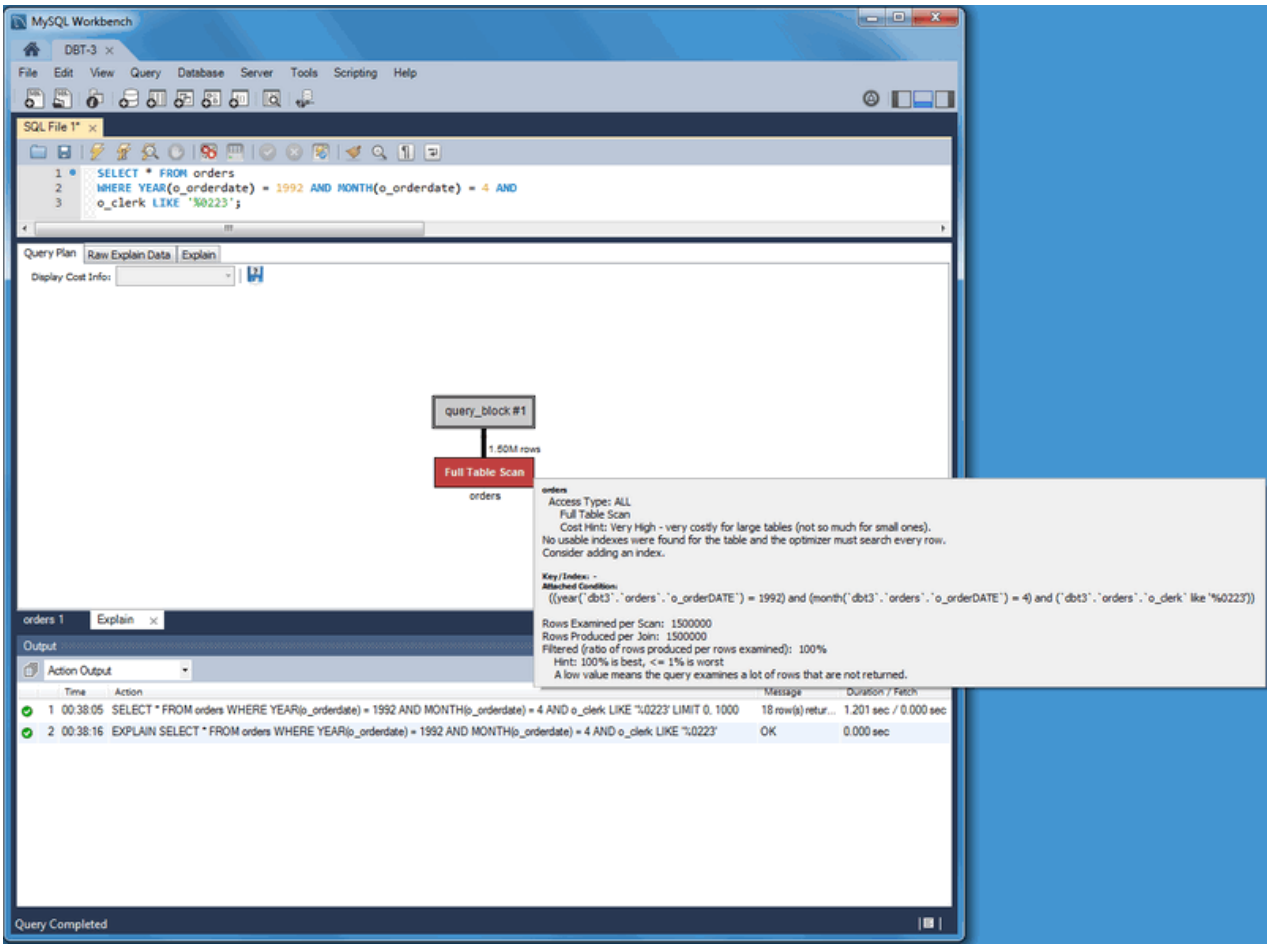

MySQL Workbench
DBT-3
File Edit View Query Database Server Tools Scripting Help
SQL File 1*
SELECT * FROM orders
WHERE YEAR(o_orderdate) = 1992 AND MONTH(o_orderdate) = 4 AND
o_clerk LIKE '%0223';
Query Plan
Raw Explain Data
Explain
query_block #1
1.50M rows
Full Table Scan
orders
Access Type: ALL
Full Table Scan
Cost Hint: Very High - very costly for large tables (not so much for small ones).
No usable indexes were found for the table and the optimizer must search every row.
Consider adding an index.
Rows Examined per Scan: 1500000
Rows Produced per Join: 1500000
Filtered (ratio of rows produced per rows examined): 100%
Hint: 100% is best, <= 1% is worst
A low value means the query examines a lot of rows that are not returned.
orders 1
Explain
Output
Action Output
1 00:38:05 SELECT * FROM orders WHERE YEAR(o_orderdate) = 1992 AND MONTH(o_orderdate) = 4 AND o_clerk LIKE '%0223' LIMIT 0, 1000
18 row(s) retur...
1.201 sec / 0.000 sec
2 00:38:16 EXPLAIN SELECT * FROM orders WHERE YEAR(o_orderdate) = 1992 AND MONTH(o_orderdate) = 4 AND o_clerk LIKE '%0223'
OK
0.000 sec
Query Completed

Figure 7.9 DBT-3 Visual Explain Tutorial: Full Table Scan: Traditional View

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	orders	ALL	NULL	NULL	NULL	NULL	1500000	Using where

Notice that ...

Why did this query generate a full table scan? Why is our indexed `o_orderdate` column missing as a possible key? Looking more closely, we notice that our indexed column is being used in an expression as `"WHERE YEAR(o_orderdate) = 1992 AND MONTH(o_orderdate) = 4"`, so its index is not used. To use the existing index we can adjust the query like so:

```
SELECT * FROM orders
WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30'
AND o_clerk LIKE '%0223';
```

Figure 7.10 DBT-3 Visual Explain Tutorial: Index Range Scan

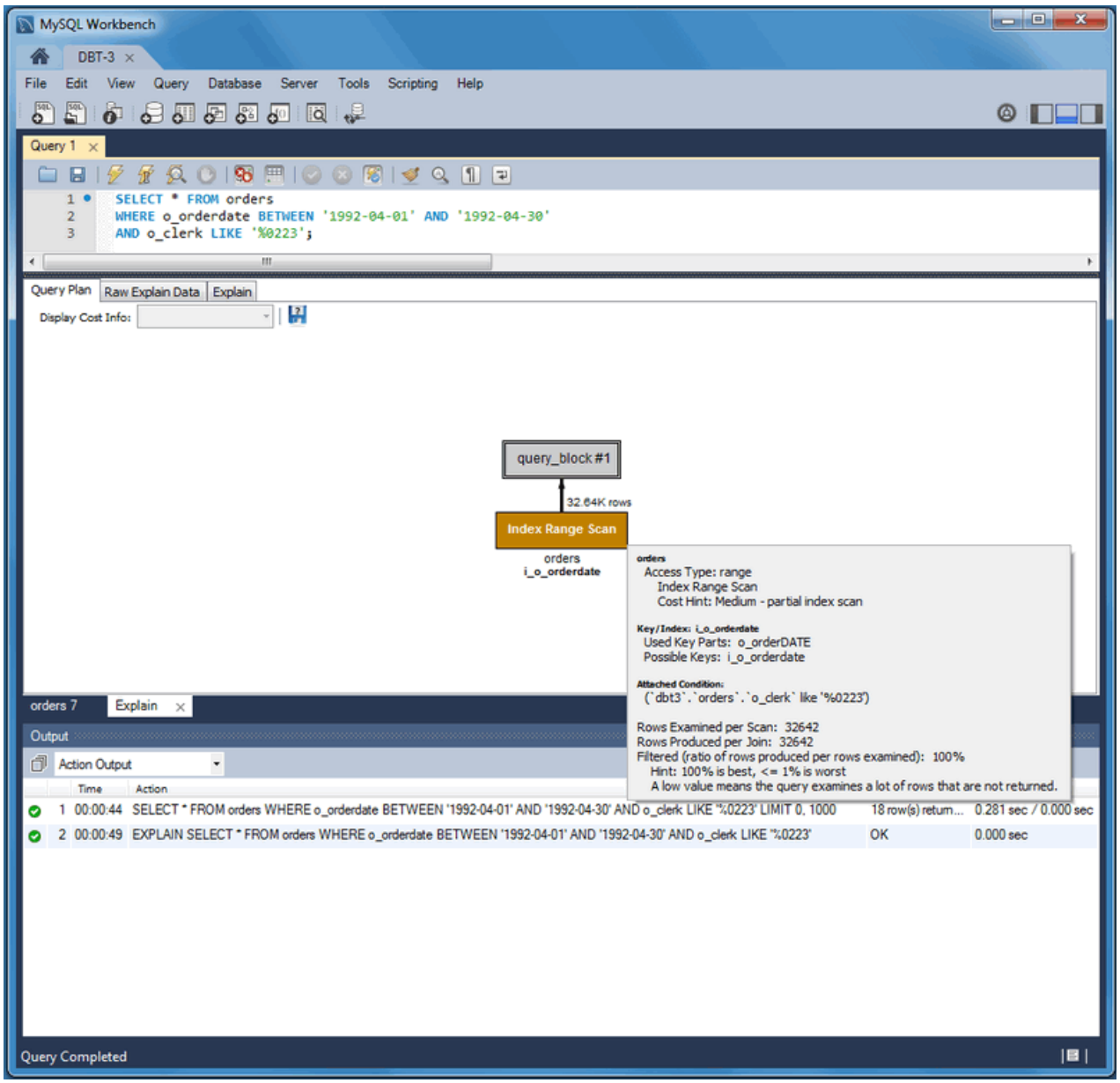

MySQL Workbench
DBT-3
File Edit View Query Database Server Tools Scripting Help
Query 1
SELECT * FROM orders
WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30'
AND o_clerk LIKE '%0223';
Query Plan
Raw Explain Data
Explain
Display Cost Info:
query_block #1
32.64K rows
Index Range Scan
orders
i_o_orderdate
orders
Access Type: range
Index Range Scan
Cost Hint: Medium - partial index scan
Key / Index: i_o_orderdate
Used Key Parts: o_orderDATE
Possible Keys: i_o_orderdate
Attached Condition:
(`dbt3`.`orders`.`o_clerk` like '%0223')
Rows Examined per Scan: 32642
Rows Produced per Join: 32642
Filtered (ratio of rows produced per rows examined): 100%
Hint: 100% is best, <= 1% is worst
A low value means the query examines a lot of rows that are not returned.
orders 7
Explain
Output
Action Output
Time Action
1 00:00:44 SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30' AND o_clerk LIKE '%0223' LIMIT 0, 1000 18 row(s) return... 0.281 sec / 0.000 sec
2 00:00:49 EXPLAIN SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30' AND o_clerk LIKE '%0223' OK 0.000 sec
Query Completed

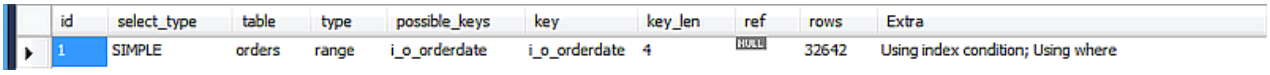
Figure 7.11 DBT-3 Visual Explain Tutorial: Index Range Scan: Traditional View

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	orders	range	i_o_orderdate	i_o_orderdate	4	NULL	32642	Using index condition; Using where

Notice the differences. The Type changed from ALL to range, possible keys (and used key) changed from NULL to i_o_orderdate, and the number of scanned rows changed from 1.5 million to about 33 thousand. Still, scanning 33 thousand rows while returning just 18 is unnecessary, so we focus on the `o_clerk` column. An index here should improve performance: so:

```
CREATE INDEX i_o_clerk ON orders(o_clerk);
```

Figure 7.12 DBT-3 Visual Explain Tutorial: Index Range Scan: Traditional View, After Index



id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	orders	range	i_o_orderdate	i_o_orderdate	4	NULL	32642	Using index condition; Using where

Notice that our new index is not being considered as a possible key. This is because we are searching the suffix of the `o_clerk` column, and indexes do not work with suffixes (although they do work with prefixes). In our simple case, we were being lazy and could have simply used the entire clerk ID. Adjusting the query shows better results:

```
SELECT * FROM orders
WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30'
AND o_clerk LIKE 'Clerk#000000223';
```

Figure 7.13 DBT-3 Visual Explain Tutorial: Index Range Scan: Better

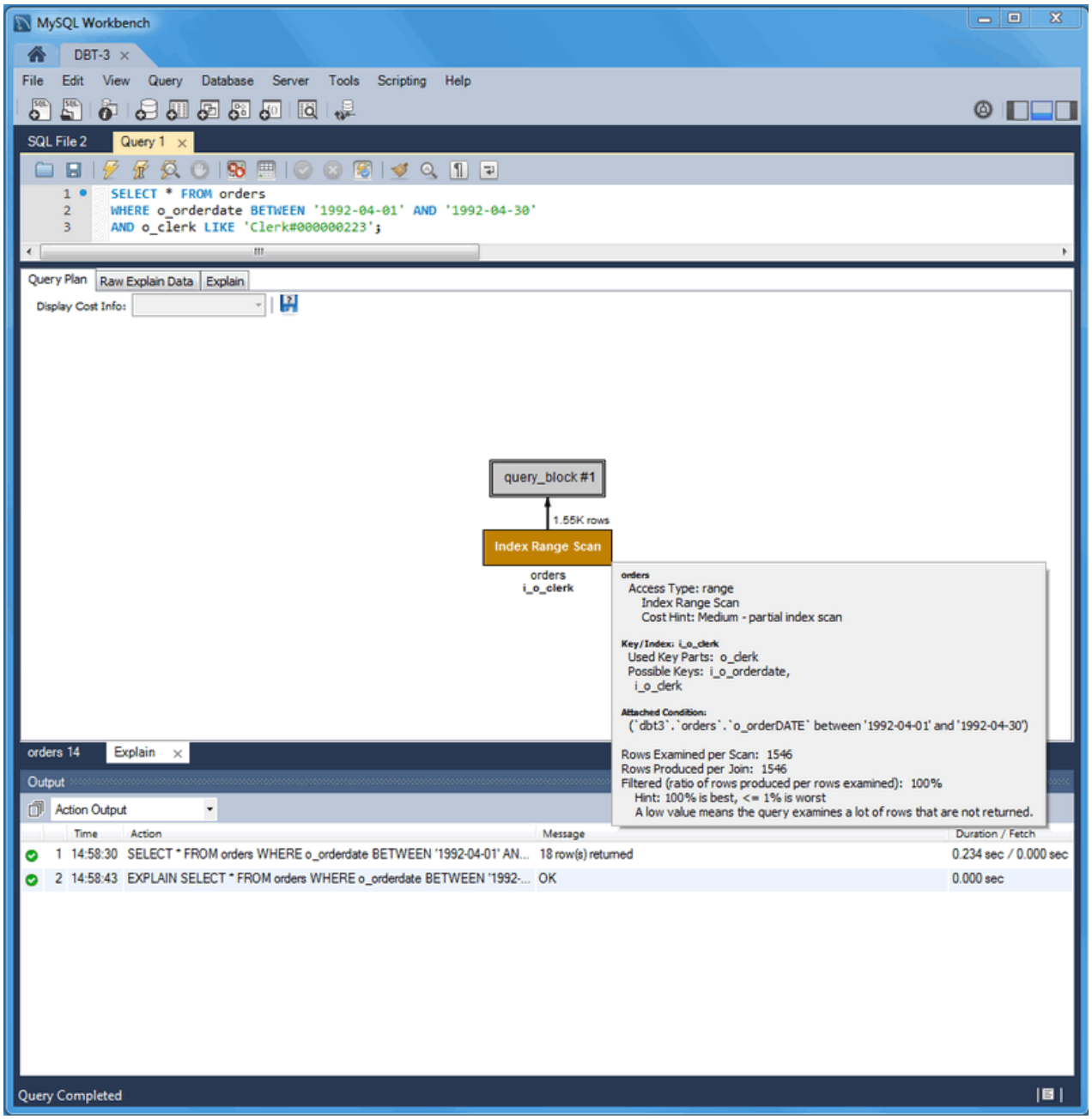

MySQL Workbench
DBT-3
File Edit View Query Database Server Tools Scripting Help
SQL File 2
Query 1
SELECT * FROM orders
WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30'
AND o_clerk LIKE 'Clerk#000000223';
Query Plan
Raw Explain Data
Explain
Display Cost Info:
query_block #1
1.55K rows
Index Range Scan
orders
i_o_clerk
orders
Access Type: range
Index Range Scan
Cost Hint: Medium - partial index scan
Key/Index: i_o_clerk
Used Key Parts: o_clerk
Possible Keys: i_o_orderdate,
i_o_clerk
Attached Condition:
(`dbt3`.`orders`.`o_orderDATE` between '1992-04-01' and '1992-04-30')
Rows Examined per Scan: 1546
Rows Produced per Join: 1546
Filtered (ratio of rows produced per rows examined): 100%
Hint: 100% is best, <= 1% is worst
A low value means the query examines a lot of rows that are not returned.
orders 14
Explain
Output
Action Output
Time Action Message Duration / Fetch
1 14:58:30 SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-04-01' AN... 18 row(s) returned 0.234 sec / 0.000 sec
2 14:58:43 EXPLAIN SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-... OK 0.000 sec
Query Completed

Figure 7.14 DBT-3 Visual Explain Tutorial: Index Range Scan: Better (Traditional)

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	orders	range	i_o_orderdate,i_o_clerk	i_o_clerk	16		1546	Using index condition; Using where

The new `o_clerk` index was considered and used, and our query scanned 1546 rows instead of 32642, and the query execution improved from 0.281 to 0.234 seconds. However, EXPLAIN estimates that this query scans 1546 rows to return 18. After reviewing our query, notice that a multi-column index can meet the conditions of our WHERE clause that is based on both the `o_orderdate` and `o_clerk` columns:

```
CREATE INDEX io_clerk_date ON orders(o_clerk, o_orderdate)
```

Note

We listed `o_clerk` as the first column in our index because `o_orderdate` uses a range. ...

Now, executing the same query shows even better results. An estimated 18 rows are both scanned and returned, and the execution time of our query is 0.234 seconds.

Figure 7.15 DBT-3 Visual Explain Tutorial: Index Range Scan: Best

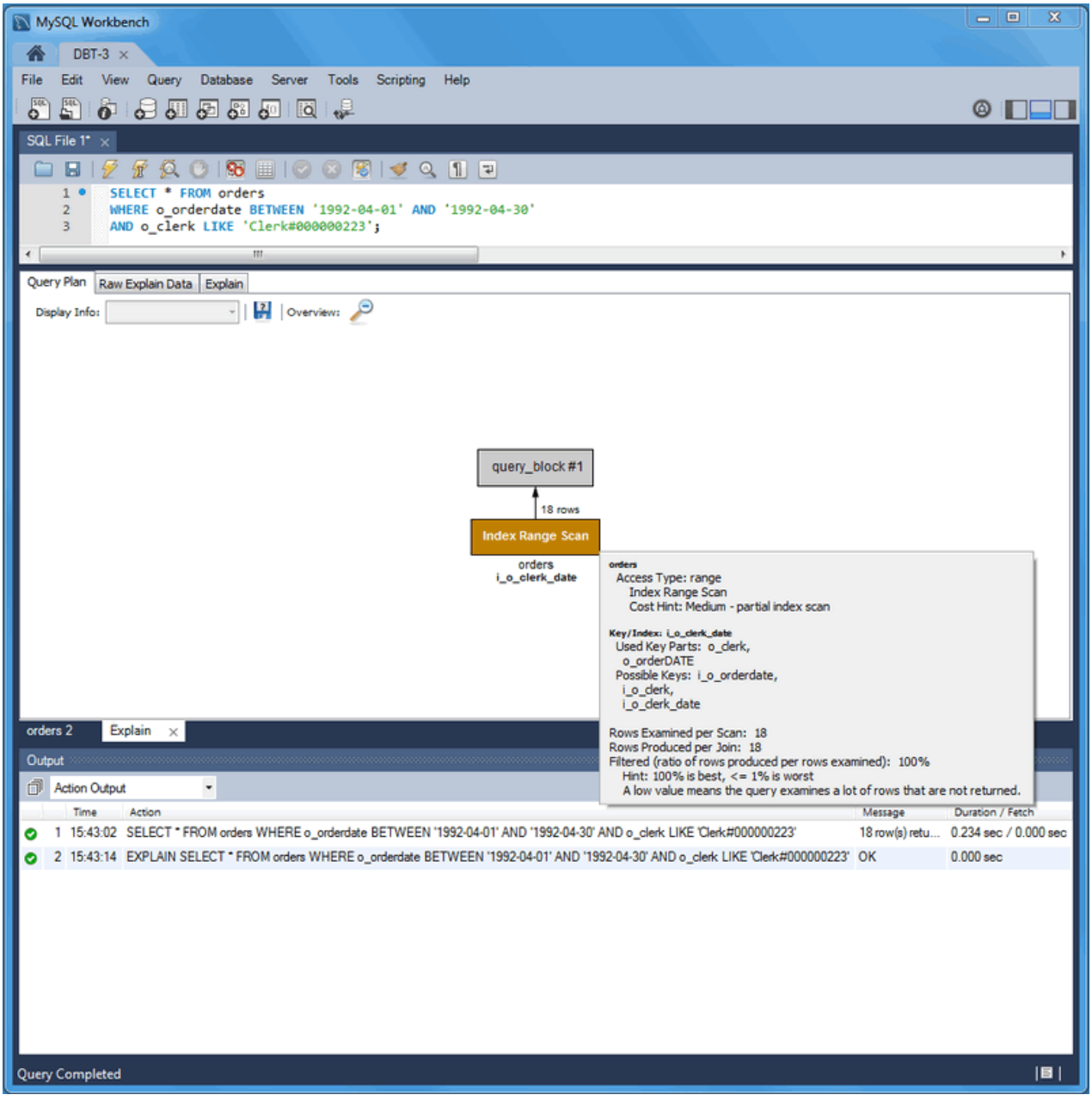

MySQL Workbench
DBT-3
File Edit View Query Database Server Tools Scripting Help
SQL File 1*
SELECT * FROM orders
WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30'
AND o_clerk LIKE 'Clerk#000000223';
Query Plan
Raw Explain Data
Explain
Display Info:
Overview:
query_block #1
18 rows
Index Range Scan
orders
i_o_clerk_date
orders
Access Type: range
Index Range Scan
Cost Hint: Medium - partial index scan
Key/Index: i_o_clerk_date
Used Key Parts: o_clerk,
o_orderDATE
Possible Keys: i_o_orderdate,
i_o_clerk,
i_o_clerk_date
Rows Examined per Scan: 18
Rows Produced per Join: 18
Filtered (ratio of rows produced per rows examined): 100%
Hint: 100% is best, <= 1% is worst
A low value means the query examines a lot of rows that are not returned.
orders 2
Explain
Output
Action Output
Time Action Message Duration / Fetch
1 15:43:02 SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30' AND o_clerk LIKE 'Clerk#000000223' 18 row(s) retu... 0.234 sec / 0.000 sec
2 15:43:14 EXPLAIN SELECT * FROM orders WHERE o_orderdate BETWEEN '1992-04-01' AND '1992-04-30' AND o_clerk LIKE 'Clerk#000000223' OK 0.000 sec
Query Completed

Figure 7.16 DBT-3 Visual Explain Tutorial: Index Range Scan: Best (traditional)

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	orders	range	i_o_orderdate,i_o_clerk,i_o_clerk_date	i_o_clerk_date	20		18	Using index condition

To summarize the results:

Table 7.2 DBT-3 Visual Explain Tutorial Query Comparison

Type	Possible keys	Key	Rows Scanned	Duration (seconds)	Extra info	Rows returned
all	NULL	NULL	1.50M	1.201	Using where	18
range	i_o_orderdate	i_o_orderdate	32642	0.281	Using index condition; Using where	18
range	i_o_orderdate, i_o_clerk	i_o_clerk	1546	0.234	Using index condition; Using where	18
range	i_o_orderdate, i_o_clerk, i_o_clerk_date	i_o_clerk_date	18	0.234	Using index condition	18

Chapter 8 Database Development

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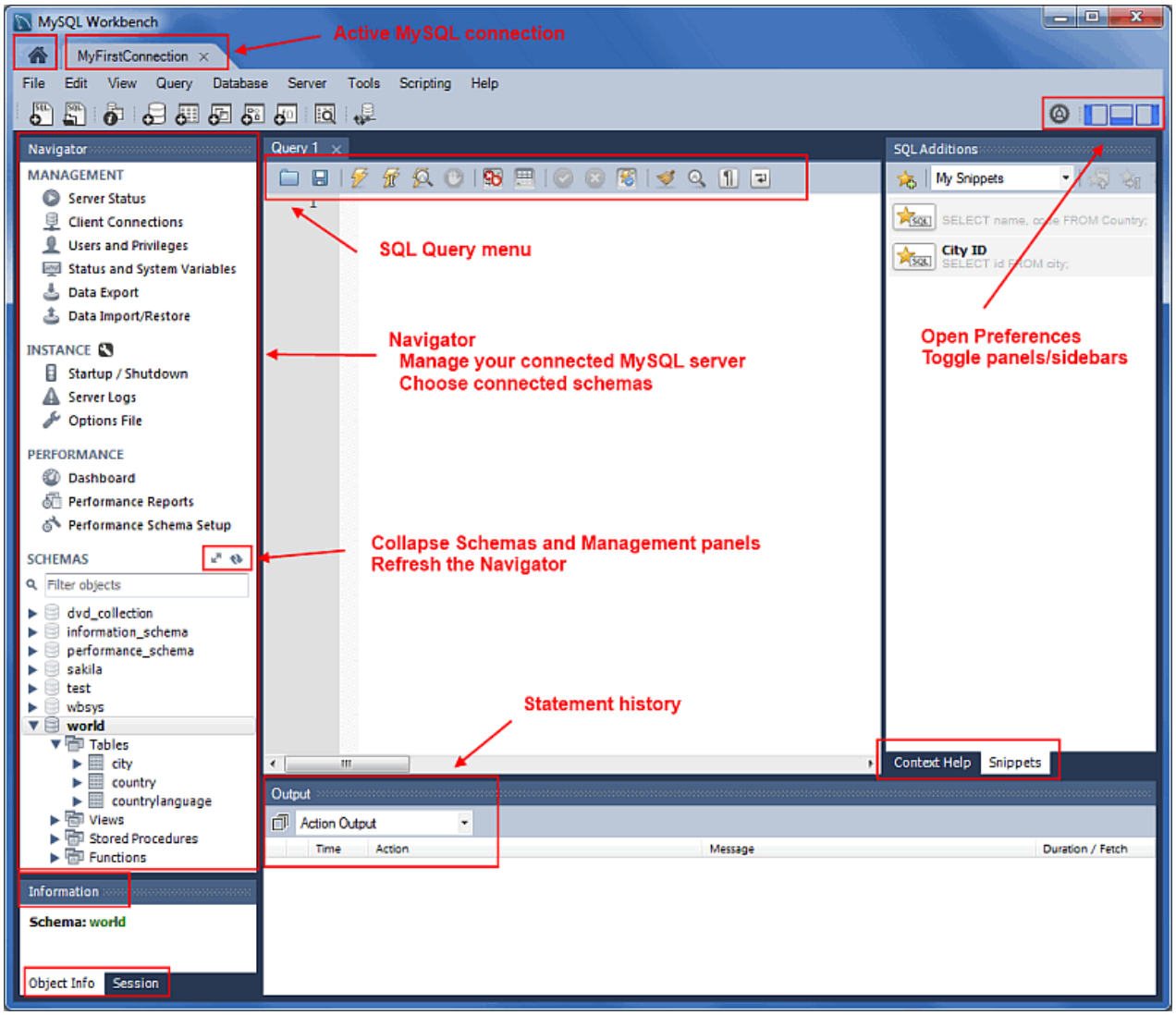
A set of visual tools to create, edit, and manage SQL queries, database connections, and objects.

8.1 Visual SQL Editor

The visual SQL Editor lets you build, edit and run queries, create and edit data, and view and export results. Color syntax highlighting, context sensitive help and auto-complete helps write and debug SQL statements. The integrated EXPLAIN plans provide data to help optimize the your queries.

Figure 8.1 SQL Editor GUI



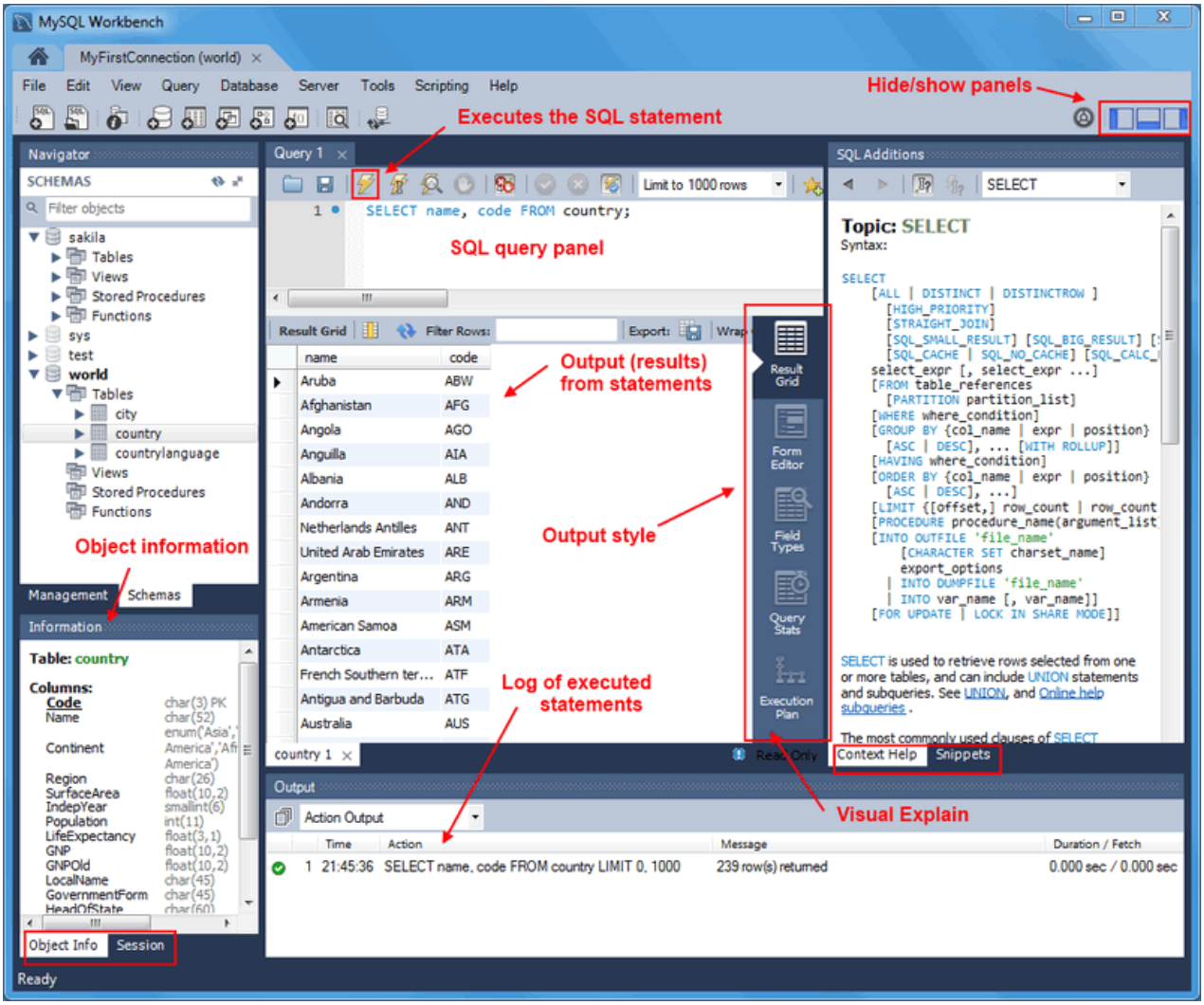
The following sections describe how to use the visual SQL editor.

8.1.1 SQL Query Window

In this area, you can enter SQL statements directly. The statements entered can be saved to a file or snippet for later use. At any point, you can also execute the statements you have entered.

To save a snippet of code entered into the SQL Query panel, click the `Save SQL to Snippets List` icon in the **Snippets** panel, enter a name (optional), and click OK. The snippet can be inserted into the SQL Query panel at any time by double-clicking the snippet in the SQL Snippets panel.

Figure 8.2 SQL Editor - SQL Query Panel



Executing a SELECT query will display the associated result set in the SQL View panel, directly below the SQL Query panel. These cells are editable if MySQL Workbench is able to determine how, as for example they are editable if a Primary or Unique key exists within the result set. If not, MySQL Workbench will display a "read-only" icon at the bottom-right corner of the SQL View panel, and hovering the mouse cursor over this icon will provide a hint as to why it's not editable.

Note

To quickly enter the name of a table, view, or column, double-click the item in the Schemata Palette. The item name will be inserted into the SQL Query panel.

The SQL Editor has several configurable panels and windows, as described in the screenshot above.

8.1.2 SQL Query Window Toolbar

The toolbar features buttons in two locations, in the main toolbar and within the SQL Editor itself. The SQL Editor buttons are described below.

Figure 8.3 SQL Editor - Toolbar

From left to right, these buttons are:

- **Open an SQL Script File**: Loads contents from a saved SQL script into the SQL editor.
- **Save SQL Script to File**: Saves contents from the SQL editor into a file.
- **Execute SQL Script**: Executes the selected portion of the query, or the entire query if nothing is selected.
- **Execute Current SQL script**: Execute the statement under the keyboard cursor.
- **Explain (All or Selection)**: Execute the `EXPLAIN` command on the query under the keyboard cursor.

  A "Results Grid" tab is also displayed when executing an EXPLAIN statement. Clicking it will execute the same query, as if **Execute SQL Script** was selected.

  Alternatively, the Visual Explain plan is already available for all executed queries. Select **Execution Plan** from the results tab to view it.
- **Stop the query being executed**: Halts execution of the currently executing SQL script.

  Note

  The database connection will not be restarted, and open transactions will remain open.
- **Toggle whether execution of SQL script should continue after failed statements**: If the red “breakpoint” circle is displayed, the script terminates on a statement that fails. If the button is depressed so that the green arrow is displayed, execution continues past the failed code, possibly generating additional result sets. In either case, any error generated from attempting to execute the faulty statement is recorded in the Output tabsheet.

  This behavior can also be set from the **SQL Execution** user preferences panel.
- **Commit**: Commits the current transaction.

  Note

  All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.
- **Rollback**: Rolls back the current transaction.

  Note

  All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.
- **Toggle Auto-Commit Mode**: If selected, each statement will be committed independently.

  Note

  All query tabs in the same connection share the same transactions. To have independent transactions, a new connection must be opened.

Auto-commit is enabled by default, and this default behavior can be modified (disabled) under the **SQL Execution** user preferences panel.

- **Set Limit for Executed Queries**: The default value is 1000, which appends "LIMIT 0, 1000" to SELECT queries.

  The default (1000) can be changed from the **SQL Execution** user preferences panel.

- **Save Snippet**: Save the current statement or selection to the active snippet list.

- **Beautify SQL**: Beautify/reformat the SQL script.

  By default, SQL keywords are changed to UPPER CASE. This functionality can be changed from the **SQL Editor** user preferences panel.

- **Find panel**: Show the Find panel for the editor.

- **Invisible characters**: Toggle display of invisible characters, such as newlines, tabs, spaces.

  A new line is represented as **[LF]**, a space as a single dot (.), and a tab as a right arrow.

- **Wrapping**: Toggles the wrapping of long lines in the SQL editor window.

8.1.3 Query and Edit Menus

When an SQL Editor tab is selected, the most important items on the main menu bar are the Query and Edit menus.

SQL Query Menu

The Query menu features the following items:

- Execute (All or Selection): Executes all statements in the SQL Query area, or only the selected statements.

- Execute (All or Selection) to Text: Executes all statements in the SQL Query area, or only the selected statements, and displays it in plain text like the standard MySQL command line console.

- Execute Current Statement: Executes the current SQL statement.

- Execute Current Statement (Vertical Text Output): Executes all statements in the SQL Query area, or only the selected statements, and displays it in plain text like the MySQL command line console does vertically (\G).

- Explain Current Statement: Describes the current statement by using the MySQL EXPLAIN statement.

- Visual Explain Current Statement: Visually describes the current statement, based on EXPLAIN information provided by MySQL Server 5.6 and above. MySQL Workbench parses the EXPLAIN (JSON) output from MySQL server 5.6+, and outputs a visual representation.

  For additional information about Visual Explain, see Section 7.3, “Visual Explain Plan” and Section 7.5, “Tutorial: Using Visual Explain to improve query performance”.

- Stop: Stops executing the currently running script.

- Stop Script Execution On Errors: If enabled, MySQL Workbench stops executing the a query if errors are found. It can be enabled/disabled from this menu.

- Limit Rows: By default, the number of returned rows (LIMIT) is 1000. Values defined here affects subsequent statements. The number ranges from 10 to 50000, and "Don't Limit".
- Collect Performance Schema Stats: Provides data to the **Query Stats** result set view, which includes statement specific information about Timing, Rows processed, Temporary tables, Joins per type, Sorting, and Index usage.
- Collect Resultset Field Metadata: Provides data to the **Form Editor** and **Field Types** result set views.
- Reconnect to Server: Reconnects to the MySQL server.
- New Tab to Current Server: Creates a duplicate of the current SQL Editor tab.
- Auto-Commit Transactions: Enable to auto-commit transactions.
- Commit Transaction: Commits a database transaction.
- Rollback Transaction: Rolls back a database transaction.
- Commit Result Edits: Commits any changes you have made to the server.
- Discard Result Edits: Discards any changes you have made.
- Export Results: Exports result sets to a file. Selecting this option displays the **Export Query Results to File** dialog. The dialog enables you to select which result set you wish to export, the file format (CSV, HTML, XML), and the name and location of the output file. Then click Export to export the data.

Edit Menu

The Edit menu features the Format submenu. The Format submenu includes the following menu items:

- Beautify Query: Reformats the query selected in the query tab and lays it out in nicely indented fashion.
- UPCASE Keywords: Converts keywords to uppercase in the currently selected query in the query tab.
- lowercase Keywords: Converts keywords to lowercase in the currently selected query in the query tab.
- Un/Comment Selection: Comments the lines currently selected in the query tab. If the lines are already commented, this operation removes the comments.
- Auto-complete: Triggers the auto-completion wizard. This is enabled (and triggered) by default, and can be disabled with Preferences, SQL Editor, **Automatically Start Code Completion**. Auto-completion will list functions, keywords, schema names, table names and column names.

8.1.4 Results Window

The results area of the screen shows the results from executed statements. If the script contains multiple statements, a result tab will be generated for each statemented that returned results.

Note

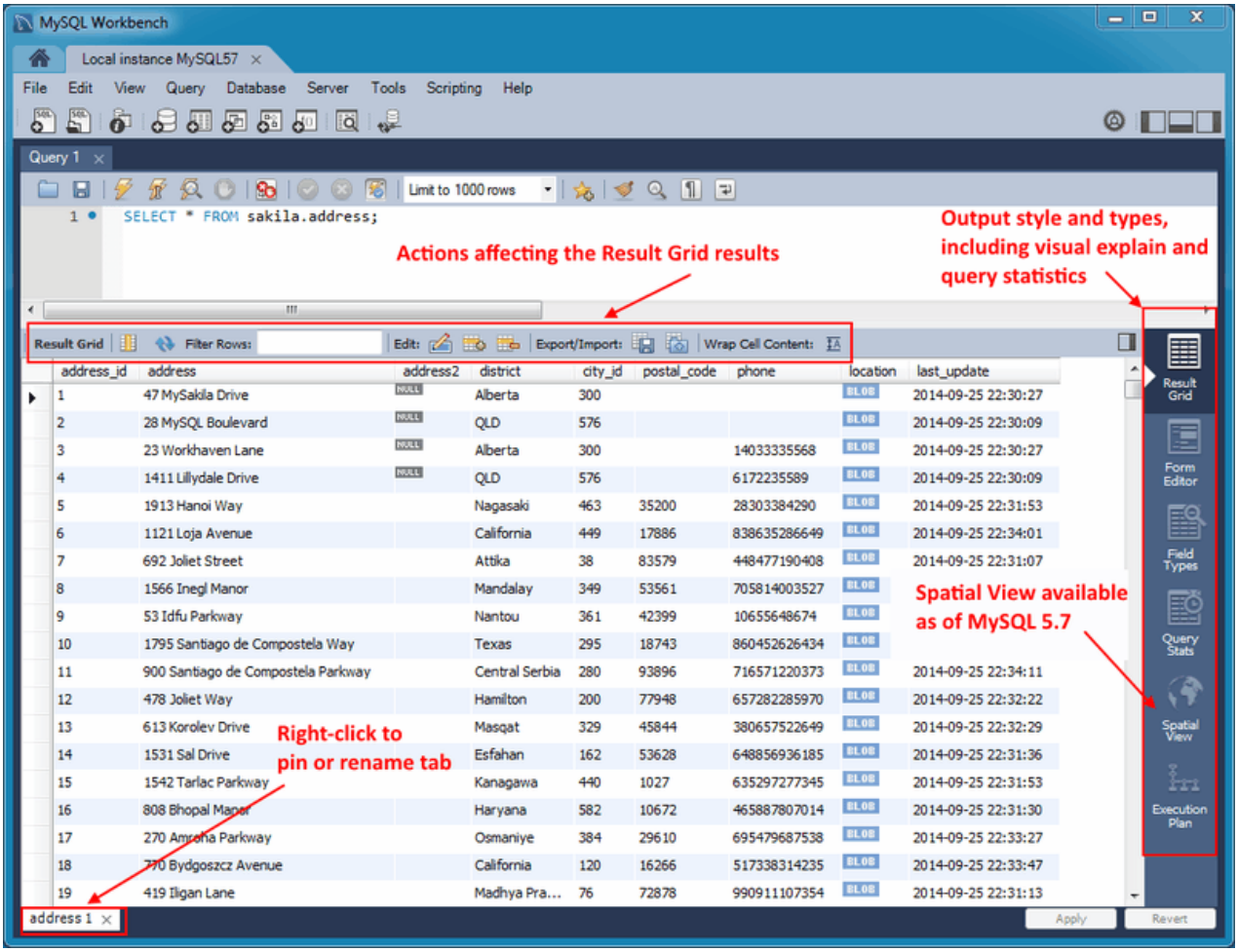
MySQL Workbench handles quoting and escaping for strings entered into the results grid, so adding quotes and proper escaping here is optional.

Note

It is possible to enter a function, or other expression, into a field. Use the prefix `\func` to prevent MySQL Workbench from escaping quotation marks. For example,

> for the expression `md5('fred')`, MySQL Workbench normally would generate the code `md5(\'fred\')`. To prevent this, enter the expression as `\func md5('fred')` to ensure that the quoting is not escaped.

Figure 8.4 SQL Editor - Result Grid


MySQL Workbench
Local instance MySQL57
File Edit View Query Database Server Tools Scripting Help
Query 1
Limit to 1000 rows
1 SELECT * FROM sakila.address;
Actions affecting the Result Grid results
Output style and types, including visual explain and query statistics
Result Grid Filter Rows: Edit: Export/Import: Wrap Cell Content:
address_id address address2 district city_id postal_code phone location last_update
1 47 MySakila Drive NULL Alberta 300 BLOB 2014-09-25 22:30:27
2 28 MySQL Boulevard NULL QLD 576 BLOB 2014-09-25 22:30:09
3 23 Workhaven Lane NULL Alberta 300 14033335568 BLOB 2014-09-25 22:30:27
4 1411 Lillydale Drive NULL QLD 576 6172235589 BLOB 2014-09-25 22:30:09
5 1913 Hanoi Way Nagasaki 463 35200 28303384290 BLOB 2014-09-25 22:31:53
6 1121 Loja Avenue California 449 17886 838635286649 BLOB 2014-09-25 22:34:01
7 692 Joliet Street Attika 38 83579 448477190408 BLOB 2014-09-25 22:31:07
8 1566 Inegl Manor Mandalay 349 53561 705814003527 BLOB
9 53 Idfu Parkway Nantou 361 42399 10655648674 BLOB
10 1795 Santiago de Compostela Way Texas 295 18743 860452626434 BLOB
11 900 Santiago de Compostela Parkway Central Serbia 280 93896 716571220373 BLOB 2014-09-25 22:34:11
12 478 Joliet Way Hamilton 200 77948 657282285970 BLOB 2014-09-25 22:32:22
13 613 Korolev Drive Masqat 329 45844 380657522649 BLOB 2014-09-25 22:32:29
14 1531 Sal Drive Esfahan 162 53628 648856936185 BLOB 2014-09-25 22:31:36
15 1542 Tarlac Parkway Kanagawa 440 1027 635297277345 BLOB 2014-09-25 22:31:53
16 808 Bhopal Manor Haryana 582 10672 465887807014 BLOB 2014-09-25 22:31:30
17 270 Amroha Parkway Osmaniye 384 29610 695479687538 BLOB 2014-09-25 22:33:27
18 770 Bydgoszcz Avenue California 120 16266 517338314235 BLOB 2014-09-25 22:33:47
19 419 Iligan Lane Madhya Pra... 76 72878 990911107354 BLOB 2014-09-25 22:31:13
Right-click to pin or rename tab
Spatial View available as of MySQL 5.7
Result Grid
Form Editor
Field Types
Query Stats
Spatial View
Execution Plan
address 1
Apply
Revert

The result grid navigation panel offers the following options:

- **Reset**: Resets all sorted columns.
- **Refresh**: Refreshes all data by re-executing the original statement.
- **Filter Rows**: performs a case-insensitive search of all cells. It automatically refreshes, and there is also the refresh button to perform this action manually.
- **Edit Current Row**: Edit the current row.
- **Add New Row**: Adds a new empty row, and highlights it in edit mode. Click Apply to execute (and review) the insert row query.
- **Delete Selected Rows**: Deletes the selected rows. Click Apply execute (and review) the delete query.
- **Export**: Writes a result set to a CSV, HTML, JSON, SQL INSERT, Excel, XML, or Tab separated file as required.

Note

This exports a result set. To export an entire table or schema, see Data Export.

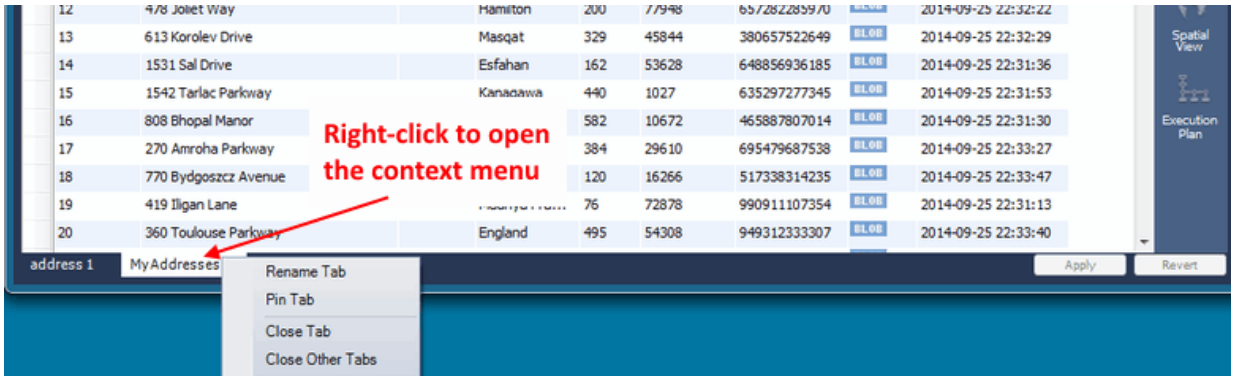
- **Import**: Import records from an external CSV file.
- **Wrap Cell Content**: If the contents of a cell exceeds the cell width, then the data will be cut off with an ellipses. This option will instead wrap the contents within the cell, and adjust the cell height accordingly.

Note

The "Refresh" button automatically adjusts the column width to match the longest string one of its cells. You may also manually adjust the column width.

Right-clicking on a results grid tab opens the following context-menu:

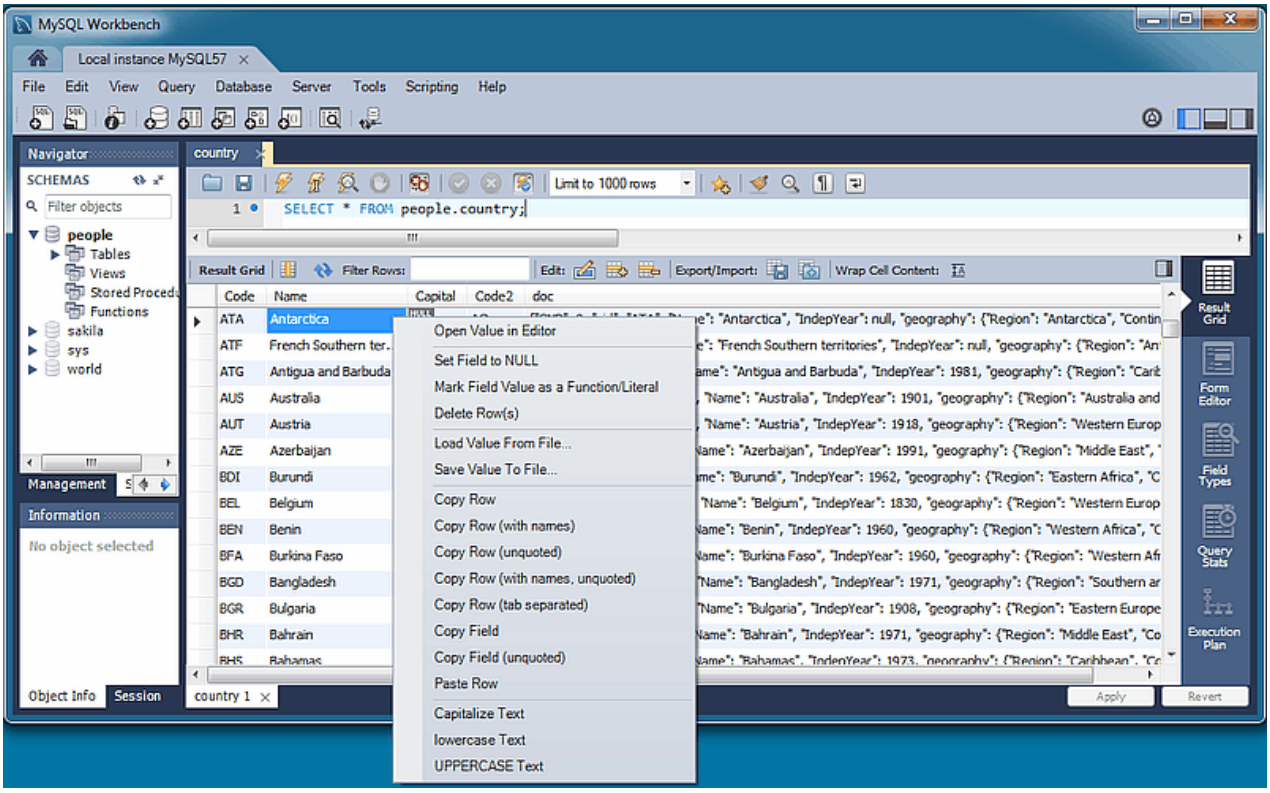
Figure 8.5 SQL Editor - Result Grid Context Menu



- Rename Tab: Customize the name (title) of this tab.
- Pin Tab: Pin the results tab to the results grid. Executing additional SQL statements will create new result grid tabs.
- Close Tab: Close this tab.
- Close Other Tabs: Close all tabs except this one.

Right-clicking on a results grid field opens the following context-menu:

Figure 8.6 SQL Editor - Result Grid Field Context Menu



- Open Value in Editor: Opens a new editor window that specializes in editing Binary and JSON data, but can edit text.
- Set Field to NULL: Sets the field value to NULL.
- Mark Field Value as a Function/Literal: Marks as a function, by prepending \func.
- Delete Row(s): Deletes the entire row.
- Load Value from File: Opens a file dialog to insert a value from a file. The entire file contents are inserted into the field.
- Save Value to File: Saves a field's value to a file.
- Copy Row: Copy the row in escaped CSV format, in a form such as: 'a', 'b','c'. Alternatively, there is Copy Row (tab separated) to use tabs instead of commas as the separator, and Copy Row (unquoted) to not escape the values.
- Copy Row (with names): Copy an escaped row like "Copy Row", but also adds a #comment containing column names. Alternatively, there is Copy Row (with names, unquoted).
- Copy Field: Copies the field name, such as: 'a', or use Copy Field (unquoted) to not use single quotes.
- Paste Row: Pastes the row over the currently selected row.
- Capitalize Text: Capitalizes text in the current row, such as: Hello World.
- lowercase Text: Lowercases text in the current row, such as: hello world.
- UPPERCASE Text: Alters row to use all capitals, such as: HELLO WORLD.

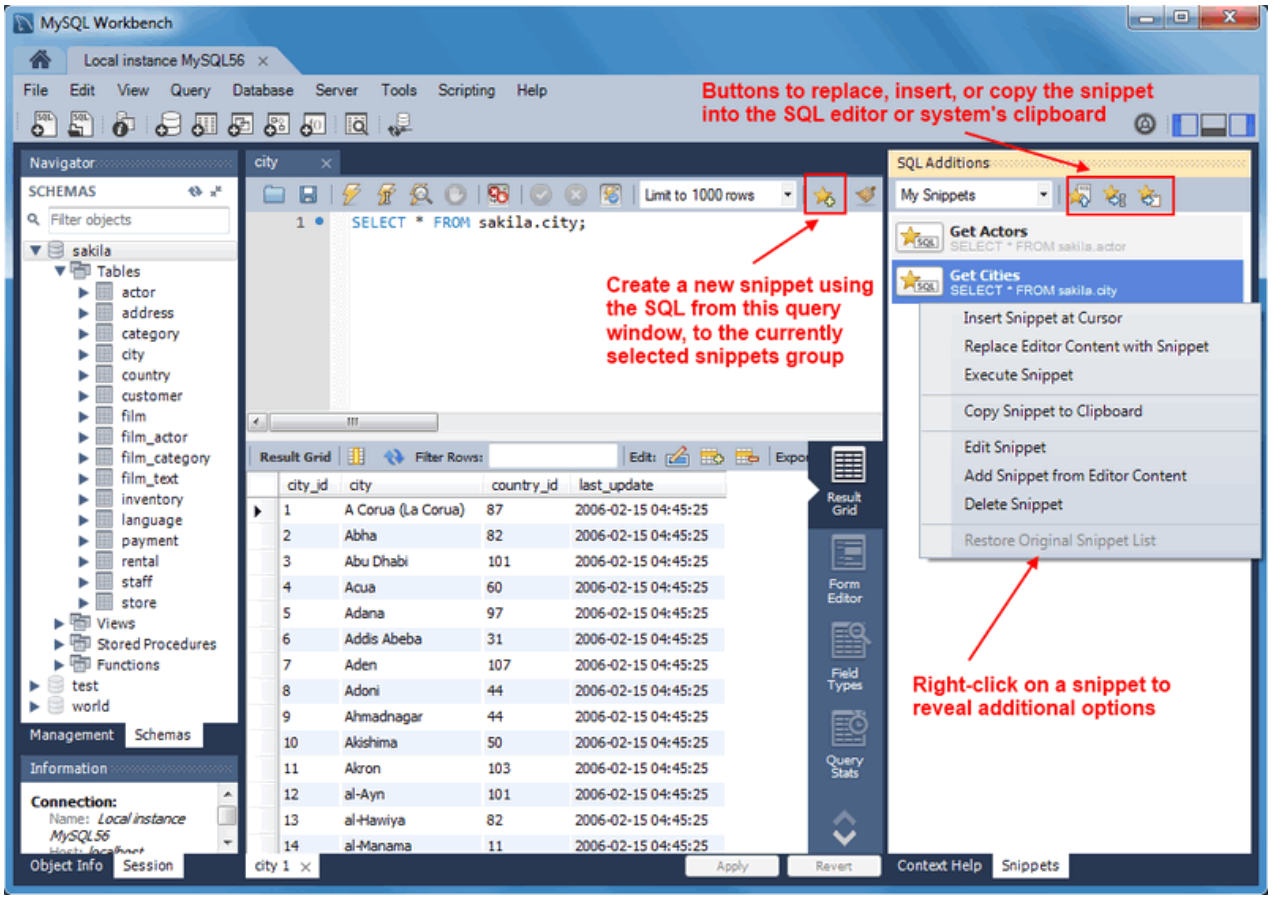
8.1.5 SQL Snippets tab

The Snippets tab includes built-in, local, and shared custom snippets. The **My Snippets** tab stores custom snippets in a file under the MySQL Workbench user's configuration directory. Select the **Shared** option for shared snippets.

Using Snippets

Snippets can be inserted into the SQL editor or the system's clipboard. To insert (use) a snippet, either use the snippet icons or right-click on the desired snippet and choose Insert.

Figure 8.7 SQL Snippets: Usage



Local Snippets (My Snippets)

Local snippets are stored in the MySQL Workbench user's directory. By default, the "My Snippets" SQL snippets are stored here:

Table 8.1 Default Local Snippet File Location

Operating System	File Path
Windows	%AppData%\MySQL\Workbench\User Snippets.txt
OS X	~username/Library/Application Support/MySQL/Workbench/snippets/User Snippets.txt

Operating System	File Path
Linux	~username/.mysql/workbench/snippets/User Snippets.txt

Editing (or adding) snippets to "My Snippets" in MySQL Workbench edits this plain text file. Optionally, you can edit this file outside of MySQL Workbench or create new files that will also be listed under the snippets selector. For example, adding a file named "More Snippets.txt" will add a "More Snippets" section to the snippets selection box.

Shared Snippets

Shared snippets are saved in a `.mysqlworkbench` schema on the connected MySQL server. Selecting "Shared" for the first time will request permission for MySQL Workbench to create this shared `.mysqlworkbench` schema. Users connected to this MySQL server are allowed to create, edit, and use these shared snippets.

Note

Shared snippets were added in MySQL Workbench 6.2.0.

The `.mysqlworkbench` schema is hidden from within MySQL Workbench as it is considered an internal schema that does not need to be seen or edited.

Built-in Snippets

Several built-in SQL snippets are bundled with MySQL Workbench, and typically show the SQL syntax for MySQL operations. They are divided up into the following categories.

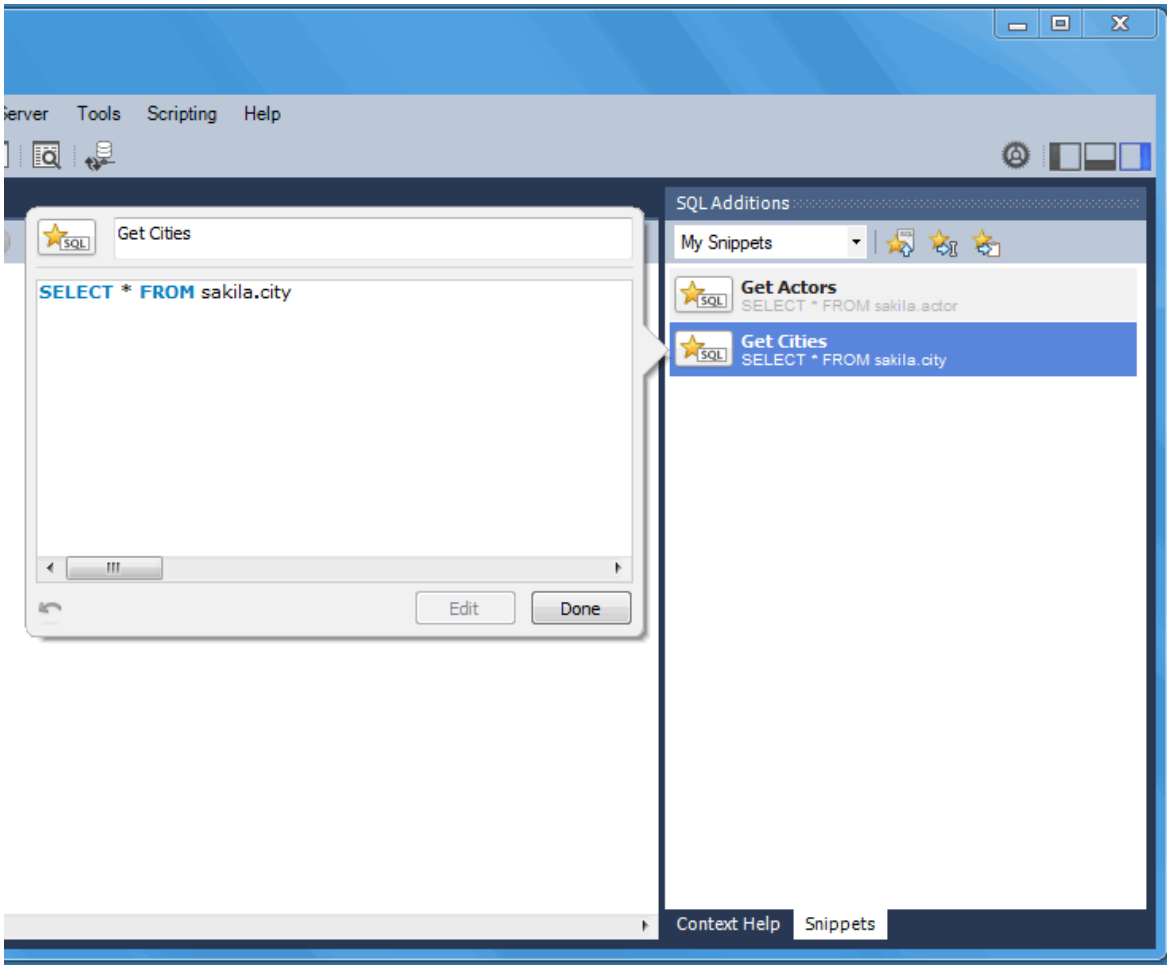
- **DB Mgmt** (Database Management): Syntax examples use `SHOW` in many forms to provide information about databases, tables, columns, or status information about the MySQL server.
- **SQL DDL** (SQL Data Definition Language): Syntax examples include creating, altering, and dropping tables, indexes, views, and procedures.
- **SQL DML** (SQL Data Manipulation Language): Syntax examples for operations such as SELECT, INSERT, and REPLACE.

The built-in operations are stored in text files in the same directory as the custom snippet files.

Saving and Editing Snippets

To save a snippet, choose the Snippets Insert icon ( ) or right-click in the snippet window and choose Add Snippet from Editor Content from the context-menu. Double-click a snippet to open it, and choose the snippet editor to edit its body or title. This example shows two snippets with only the first having defined a name.

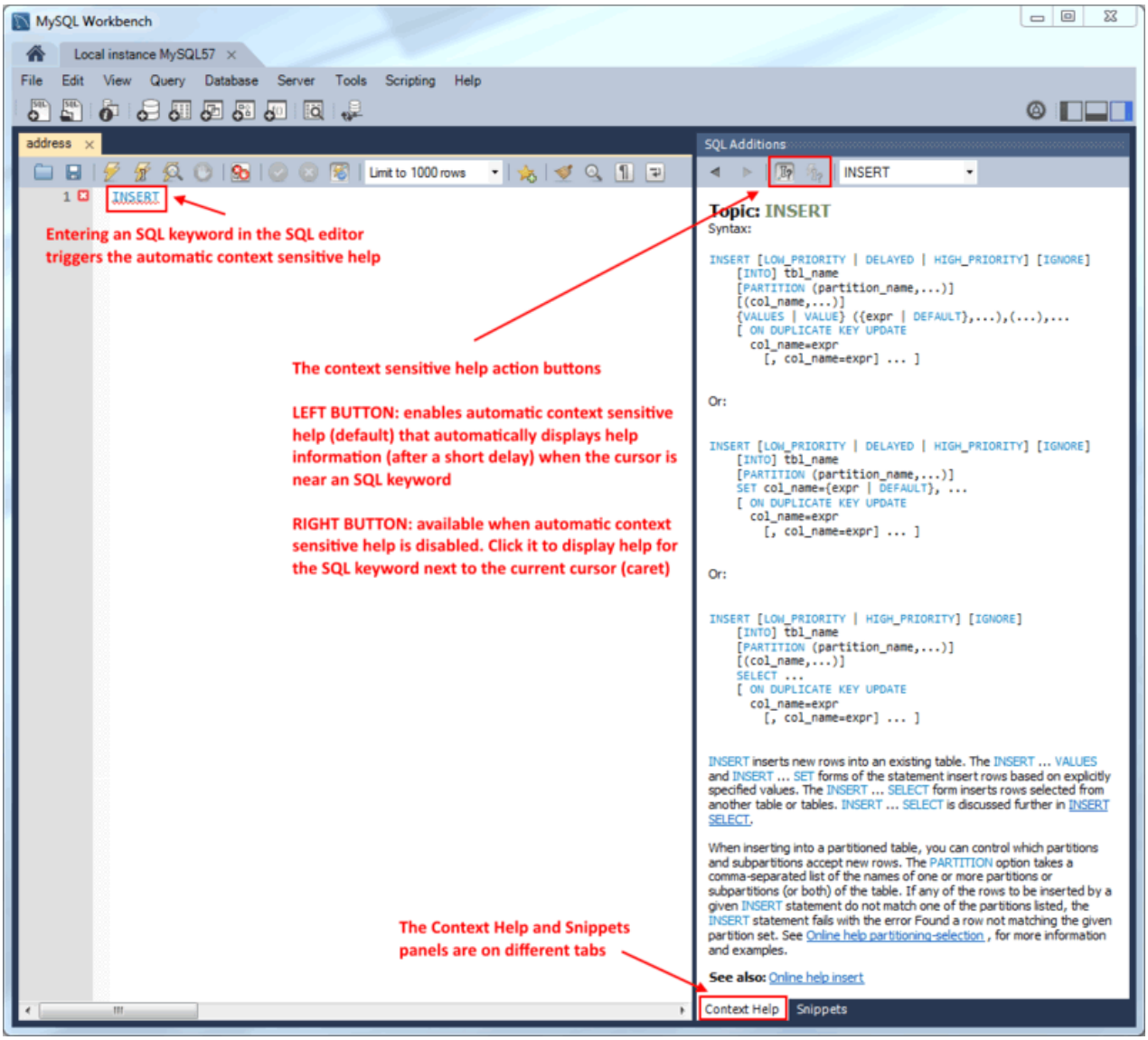
Figure 8.8 SQL Snippets: Editor



8.1.6 Context Sensitive Help

Select a keyword or function in your query, and after a delay it shows formatted help information from the MySQL Server (equivalent to using the help command from the command-line MySQL Client).

Figure 8.9 SQL Editor: Context Sensitive Help

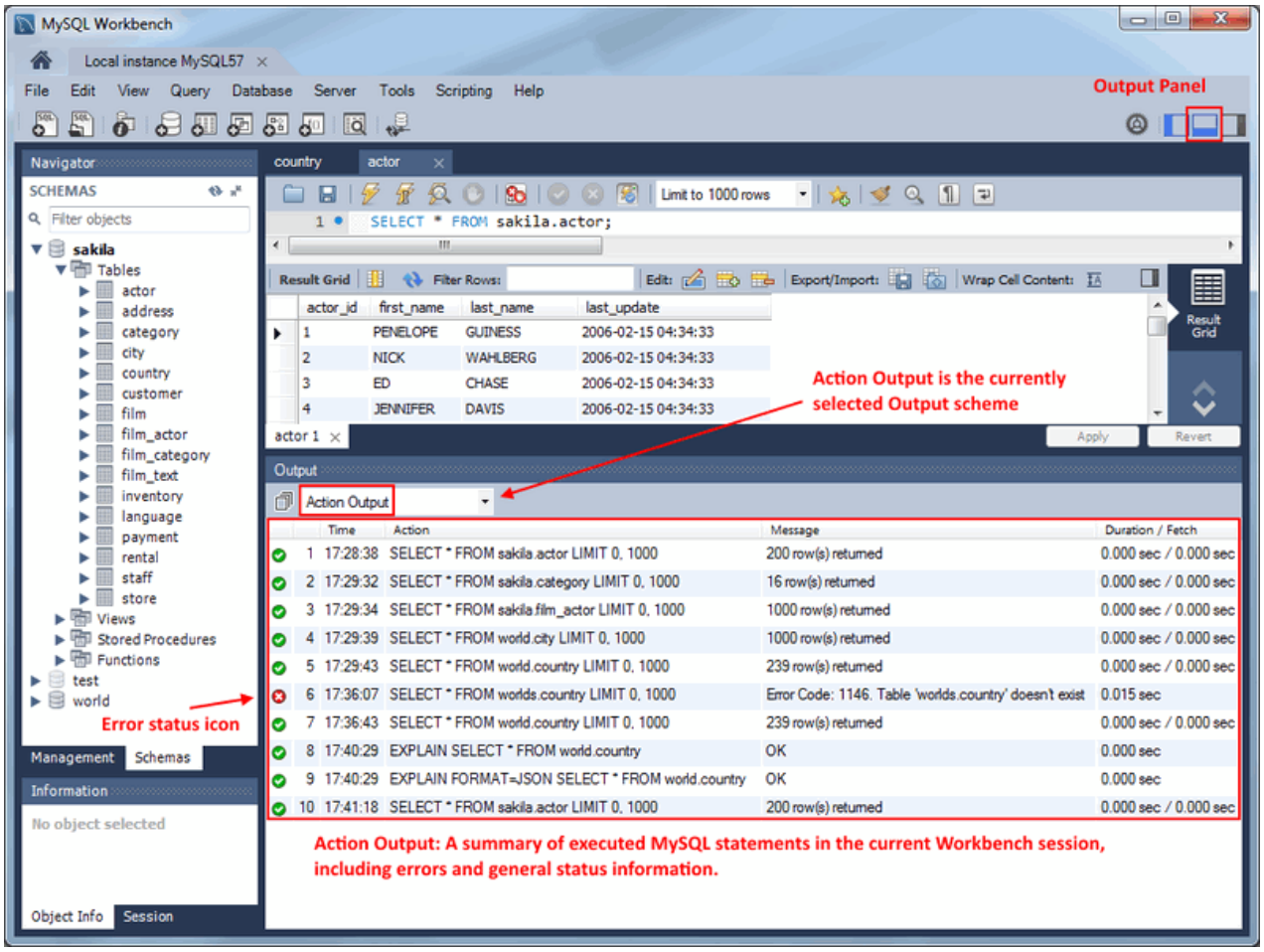

MySQL Workbench
Local instance MySQL57
File Edit View Query Database Server Tools Scripting Help
address
Limit to 1000 rows
1 INSERT
Entering an SQL keyword in the SQL editor triggers the automatic context sensitive help
The context sensitive help action buttons
LEFT BUTTON: enables automatic context sensitive help (default) that automatically displays help information (after a short delay) when the cursor is near an SQL keyword
RIGHT BUTTON: available when automatic context sensitive help is disabled. Click it to display help for the SQL keyword next to the current cursor (caret)
The Context Help and Snippets panels are on different tabs
SQL Additions
INSERT
Topic: INSERT
Syntax:
INSERT [LOW_PRIORITY | DELAYED | HIGH_PRIORITY] [IGNORE]
[INTO] tbl_name
[PARTITION (partition_name,...)]
[(col_name,...)]
{VALUES | VALUE} ({expr | DEFAULT},...),(...),...
[ON DUPLICATE KEY UPDATE
col_name=expr
[, col_name=expr] ...]
Or:
INSERT [LOW_PRIORITY | DELAYED | HIGH_PRIORITY] [IGNORE]
[INTO] tbl_name
[PARTITION (partition_name,...)]
SET col_name={expr | DEFAULT}, ...
[ON DUPLICATE KEY UPDATE
col_name=expr
[, col_name=expr] ...]
Or:
INSERT [LOW_PRIORITY | HIGH_PRIORITY] [IGNORE]
[INTO] tbl_name
[PARTITION (partition_name,...)]
[(col_name,...)]
SELECT ...
[ON DUPLICATE KEY UPDATE
col_name=expr
[, col_name=expr] ...]
INSERT inserts new rows into an existing table. The INSERT ... VALUES and INSERT ... SET forms of the statement insert rows based on explicitly specified values. The INSERT ... SELECT form inserts rows selected from another table or tables. INSERT ... SELECT is discussed further in INSERT SELECT.
When inserting into a partitioned table, you can control which partitions and subpartitions accept new rows. The PARTITION option takes a comma-separated list of the names of one or more partitions or subpartitions (or both) of the table. If any of the rows to be inserted by a given INSERT statement do not match one of the partitions listed, the INSERT statement fails with the error Found a row not matching the given partition set. See Online help partitioning-selection , for more information and examples.
See also: Online help insert
Context Help
Snippets

8.1.7 Output History Panel

The **Output** is located at the bottom of MySQL Workbench. Its select box includes the `Action Output`, `History Output`, and `Text Output` options.

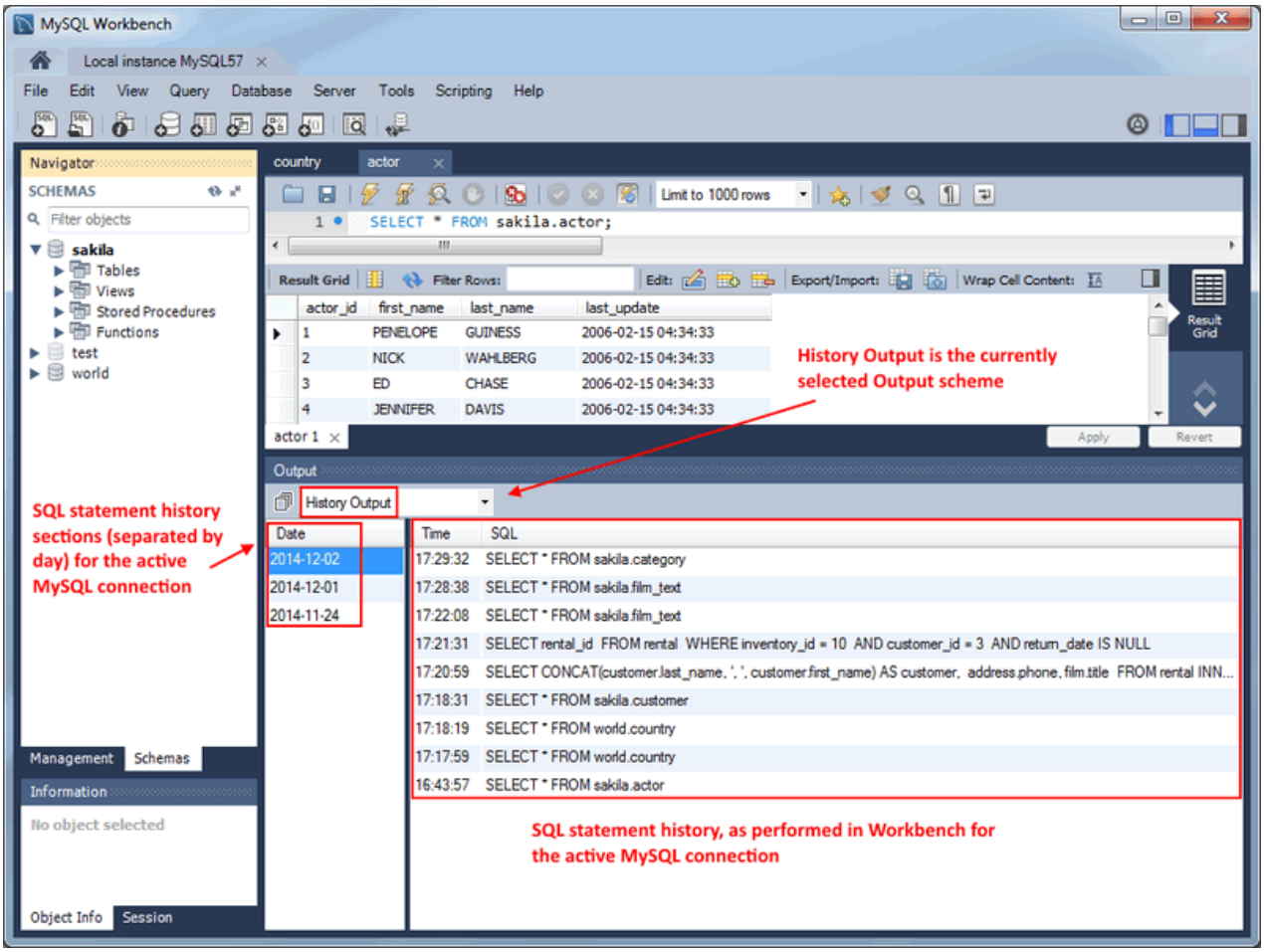
The **Action Output** panel displays a summary of the communication between the active MySQL connection in MySQL Workbench and the MySQL server, and can refer to errors or general information. Each message displays the time, action, and server response. This output is useful for troubleshooting scripts.

Figure 8.10 SQL Editor: Output: Action Output


MySQL Workbench
Local instance MySQL57
File Edit View Query Database Server Tools Scripting Help
Output Panel
Navigator
SCHEMAS
Filter objects
sakila
Tables
actor
address
category
city
country
customer
film
film_actor
film_category
film_text
inventory
language
payment
rental
staff
store
Views
Stored Procedures
Functions
test
world
Error status icon
Management
Schemas
Information
No object selected
Object Info
Session
country
actor
Limit to 1000 rows
1 SELECT * FROM sakila.actor;
Result Grid
Filter Rows:
Edit:
Export/Import:
Wrap Cell Content:
actor_id first_name last_name last_update
1 PENELOPE GUINESS 2006-02-15 04:34:33
2 NICK WAHLBERG 2006-02-15 04:34:33
3 ED CHASE 2006-02-15 04:34:33
4 JENNIFER DAVIS 2006-02-15 04:34:33
Result Grid
Action Output is the currently selected Output scheme
actor 1
Apply
Revert
Output
Action Output
Time Action Message Duration / Fetch
1 17:28:38 SELECT * FROM sakila.actor LIMIT 0, 1000 200 row(s) returned 0.000 sec / 0.000 sec
2 17:29:32 SELECT * FROM sakila.category LIMIT 0, 1000 16 row(s) returned 0.000 sec / 0.000 sec
3 17:29:34 SELECT * FROM sakila.film_actor LIMIT 0, 1000 1000 row(s) returned 0.000 sec / 0.000 sec
4 17:29:39 SELECT * FROM world.city LIMIT 0, 1000 1000 row(s) returned 0.000 sec / 0.000 sec
5 17:29:43 SELECT * FROM world.country LIMIT 0, 1000 239 row(s) returned 0.000 sec / 0.000 sec
6 17:36:07 SELECT * FROM worlds.country LIMIT 0, 1000 Error Code: 1146. Table 'worlds.country' doesn't exist 0.015 sec
7 17:36:43 SELECT * FROM world.country LIMIT 0, 1000 239 row(s) returned 0.000 sec / 0.000 sec
8 17:40:29 EXPLAIN SELECT * FROM world.country OK 0.000 sec
9 17:40:29 EXPLAIN FORMAT=JSON SELECT * FROM world.country OK 0.000 sec
10 17:41:18 SELECT * FROM sakila.actor LIMIT 0, 1000 200 row(s) returned 0.000 sec / 0.000 sec
Action Output: A summary of executed MySQL statements in the current Workbench session, including errors and general status information.

The **History Output** panel provides a history of SQL operations carried out in MySQL Workbench for the active MySQL connection. The time and SQL code for each operation is recorded. To view the executed SQL statement, click the time, and the SQL code executed will be displayed in the **SQL** column.

Figure 8.11 SQL Editor: History Output

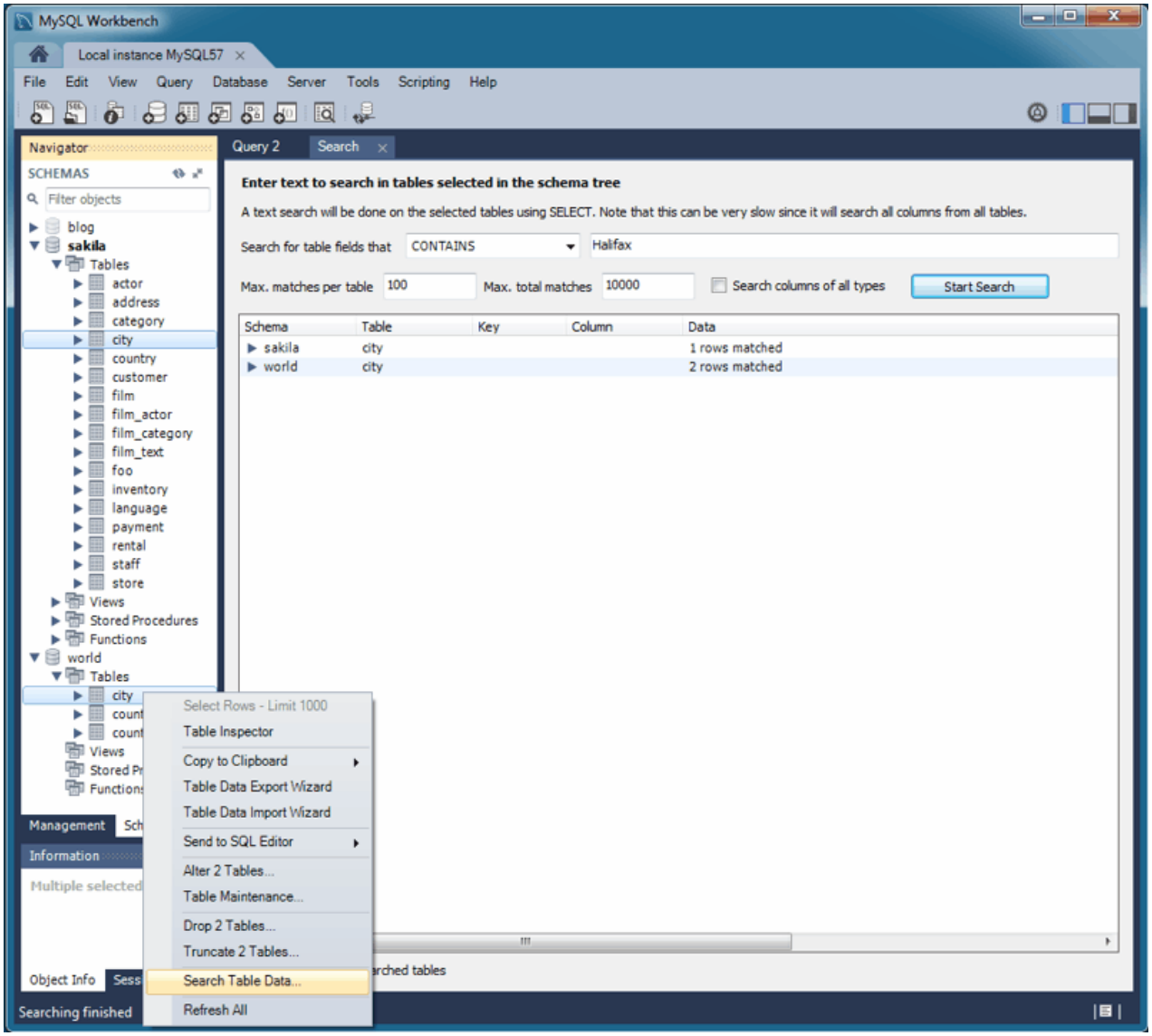


8.1.8 Table Data Search Panel

Find data across a MySQL connection by using the text search feature on any number of tables and schemas.

From the Schema Tree, choose the tables and/or schemas you want to search, and and then select Search Data Table... from the context menu.

Figure 8.12 Table Search Example: Multiple Tables and Schemas



The search options include:

- Search for table fields that: "CONTAINS", "Search using =", "Search using LIKE", "Search using REGEXP". These search options are case-insensitive.
- Max. matches per table: [*100*]
- Max. total matches: [*1000*]
- [ ] Search columns of all types: If checked, non-text column type columns are casted to CHAR to perform the matches, otherwise only text types (CHAR, VARCHAR, and TEXT) are searched. This is unchecked by default.

8.1.9 Export / Import a Table

Export or Import tables using the table export and import wizard.

Note

These wizards were added in MySQL Workbench 6.3.

Export a Table

Note

Alternatively, use Section 6.5, “Data Export and Import” to export larger sets of data, such as entire tables and databases.

Import into Table

Note

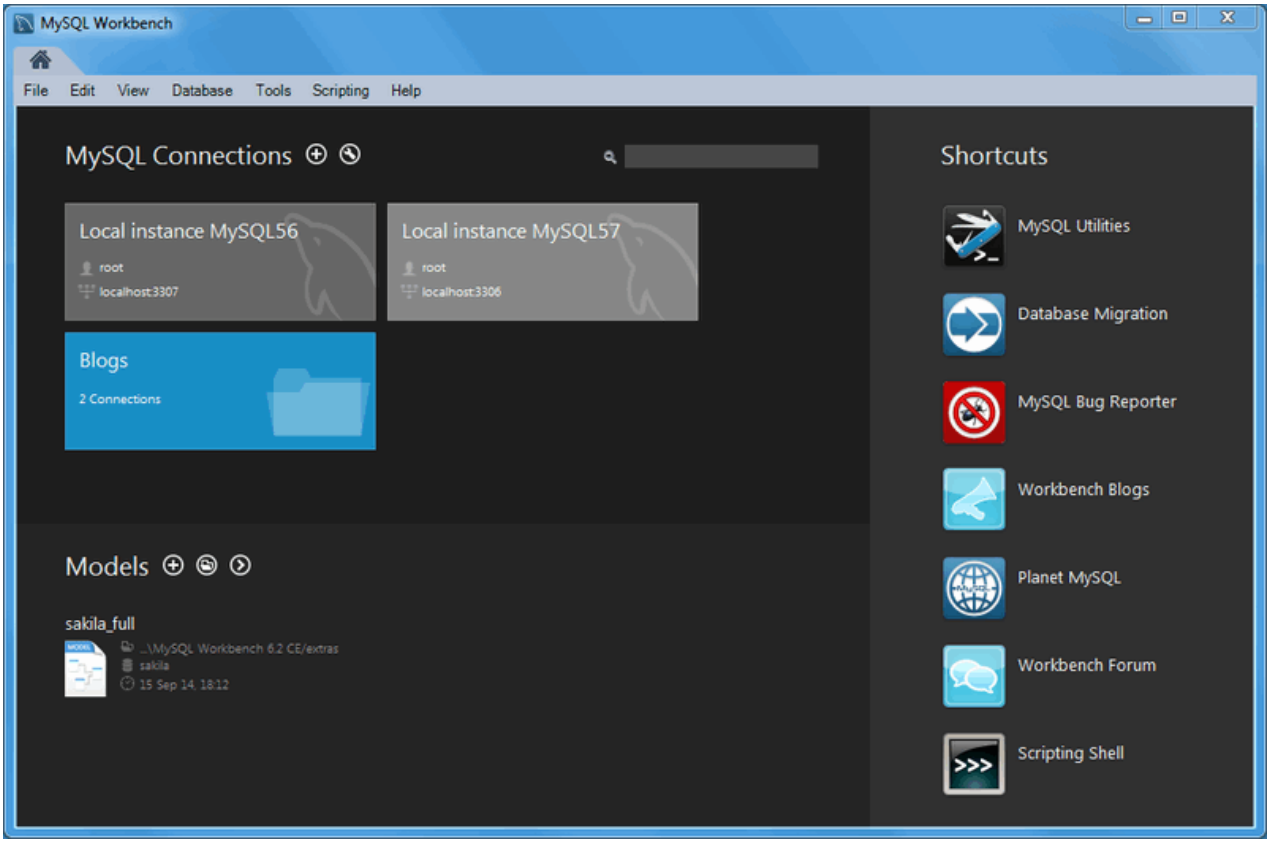
Alternatively, use Section 6.5, “Data Export and Import” to export larger sets of data, such as entire tables and databases.

8.1.10 Tutorial: Adding Data

In the previous section, you created a model, schema, and table. You also forward engineered your model to the live MySQL server. This section uses MySQL Workbench to add data into your MySQL database.

Open a MySQL connection.

Figure 8.13 Getting Started Tutorial - SQL Editor

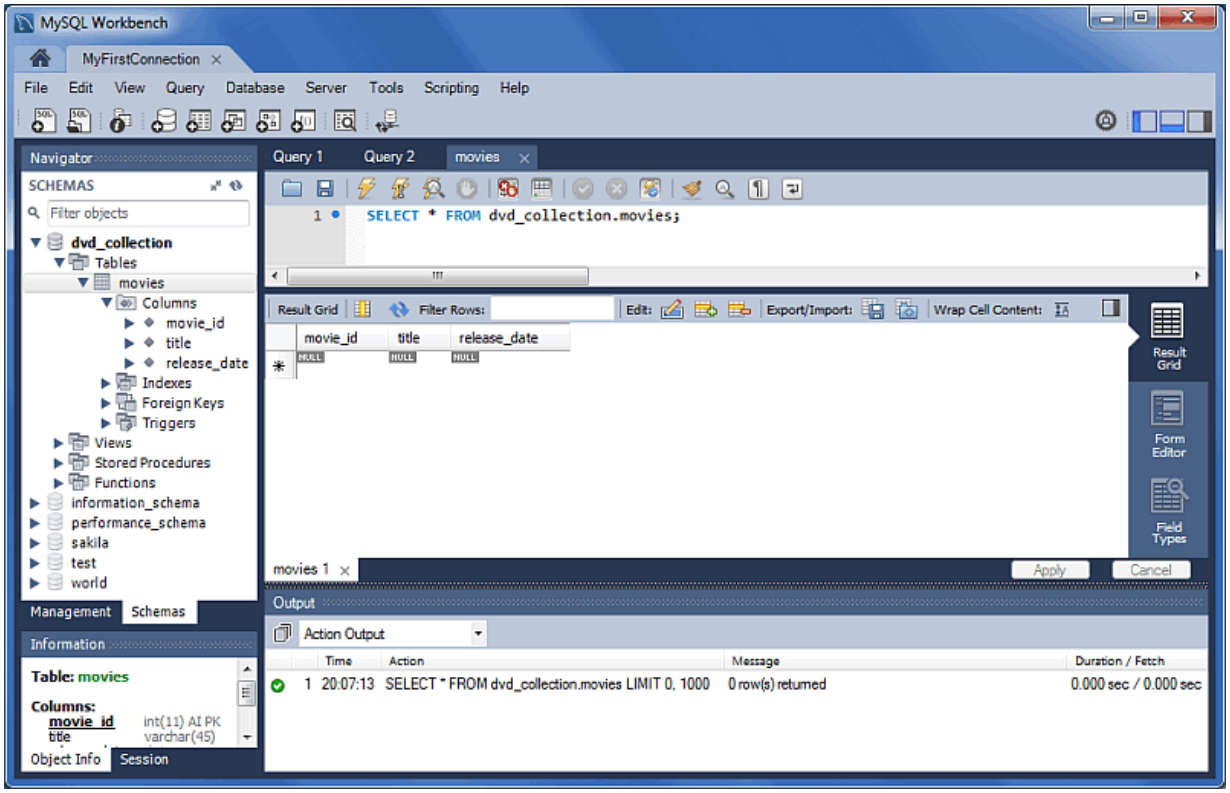


1. From the **Navigator** panel on the left, select the `movies` table from the `dvd_collection` schema that we created earlier in this tutorial. Right-click on the `movies` table and choose Select Rows - Limit 1000 from the context menu.

Note

The **Navigator** panel has both **Management** and **Schemas** tabs.

Figure 8.14 Getting Started Tutorial - Adding Data from the SQL Editor



2. This displays the query and its associated results grid. The table is empty, and data may be added into the results grid.

Note

The `movie_id` column is set to `AUTO_INCREMENT`, so values are not needed for this column.

Input the following data into the **movies** table:

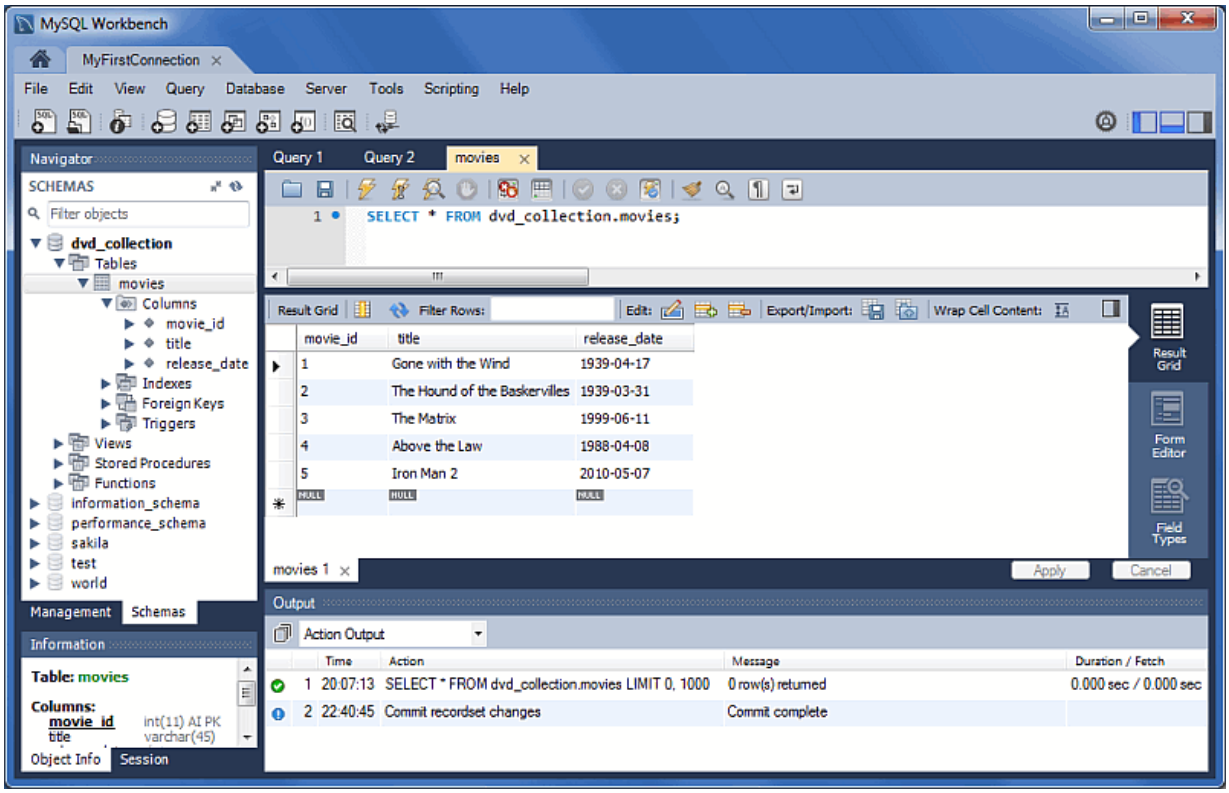
title	release_date
Gone with the Wind	1939-04-17
The Hound of the Baskervilles	1939-03-31
The Matrix	1999-06-11
Above the Law	1988-04-08
Iron Man 2	2010-05-07

Note

Do not modify `movie_id` column values.

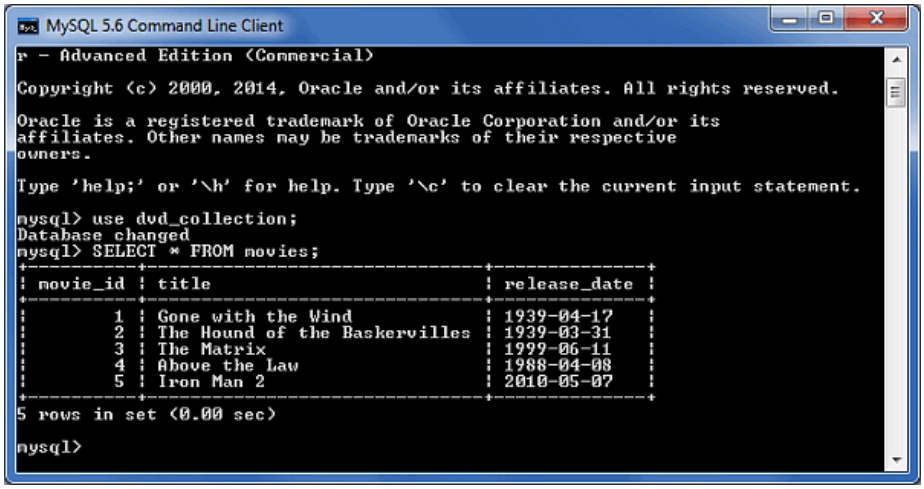
3. Click Apply to apply these changes to the live MySQL server.
4. View the data grid again and observe the generated `AUTO_INCREMENT` values.

Figure 8.15 Getting Started Tutorial - Edit Data



5. Optionally, you might confirm the changes by checking an external source, such as the MySQL Command Line Client. To check, enter `SELECT * FROM movies;` from the MySQL Command Line Client to confirm that the data was entered.

Figure 8.16 Getting Started Tutorial - View Data From The Command Line


MySQL 5.6 Command Line Client
r - Advanced Edition (Commercial)
Copyright (c) 2000, 2014, Oracle and/or its affiliates. All rights reserved.
Oracle is a registered trademark of Oracle Corporation and/or its affiliates. Other names may be trademarks of their respective owners.
Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql> use dvd_collection;
Database changed
mysql> SELECT * FROM movies;
movie_id	title	release_date
1	Gone with the Wind	1939-04-17
2	The Hound of the Baskervilles	1939-03-31
3	The Matrix	1999-06-11
4	Above the Law	1988-04-08
5	Iron Man 2	2010-05-07
5 rows in set (0.00 sec)
mysql>

6. You can also use MySQL Workbench to perform a similar check. Close the `MyFirstConnection` tab (or MySQL Workbench) and then open the `MyFirstConnection` connection from the home page. Execute `USE dvd_collection; SELECT * FROM movies;` to display the newly entered data.

In this section of the tutorial, you have learned how to add data to your database, and also how to execute SQL statements using MySQL Workbench.

For additional information about the SQL editor, see Section 8.1, “Visual SQL Editor”.

8.1.11 The MySQL Table Editor

The MySQL Table Editor is a used to create and modify tables. .ou can add or modify a table's columns or indexes, change the engine, add foreign keys, or alter the table's name.

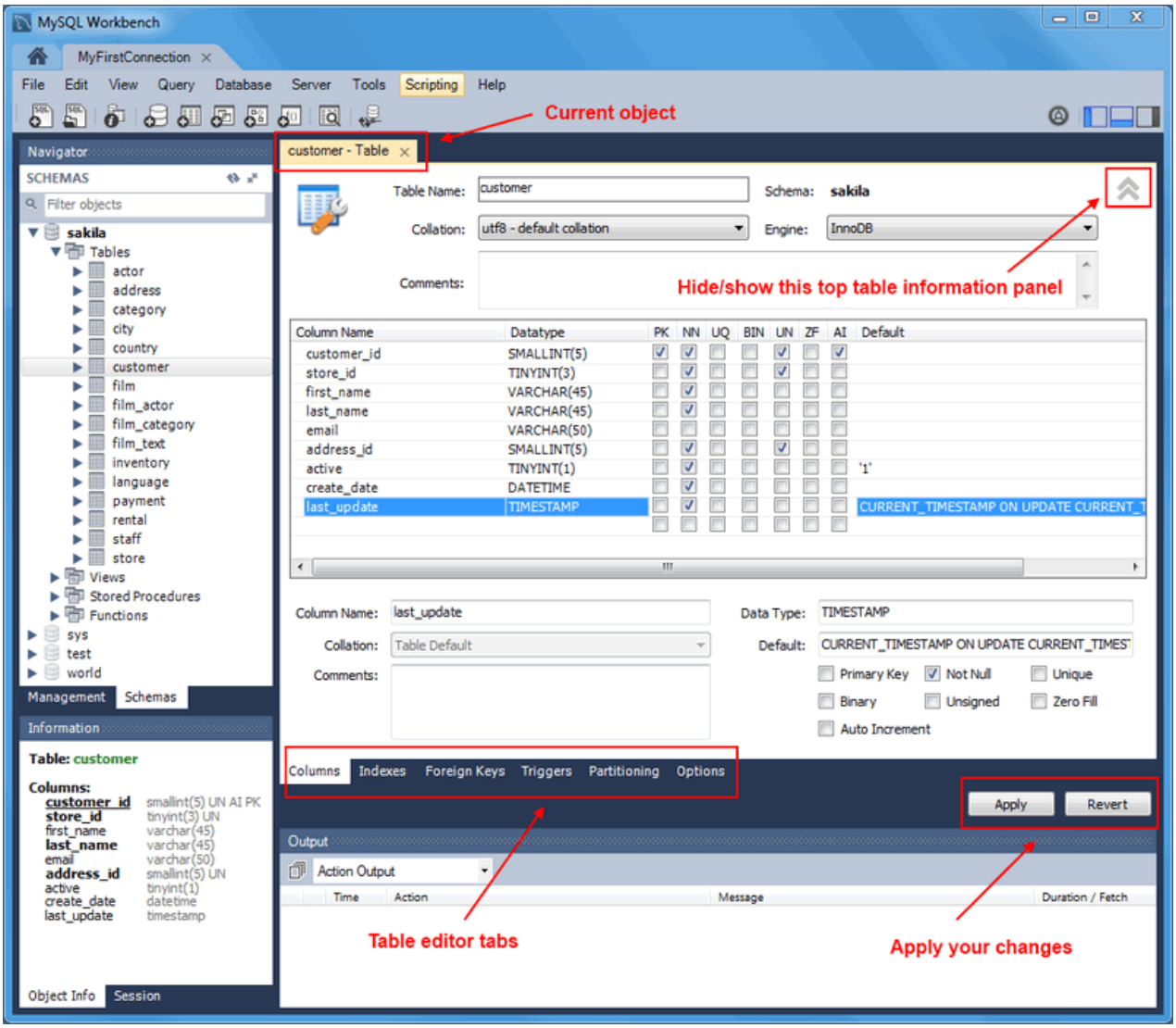
To access the MySQL Table Editor, right-click on a table name in the **Object Viewer** and choose **ALTER TABLE**. This opens a new tab within the main **SQL Editor** window. You can also access the MySQL Table Editor from an EER Diagram by double-clicking on a table object.

8.1.11.1 The Main Editor Window

Any number of tables may be edited in the MySQL Table Editor at any one time. Adding another table creates a new tab at the top of the editor. By default, the MySQL Table Editor appears docked at the top of the table editor tab, within the SQL editor..

The MySQL Table Editor is shown on top of the following figure.

Figure 8.17 The Table Editor



The MySQL Table Editor provides a work space that has tabs used to perform these actions:

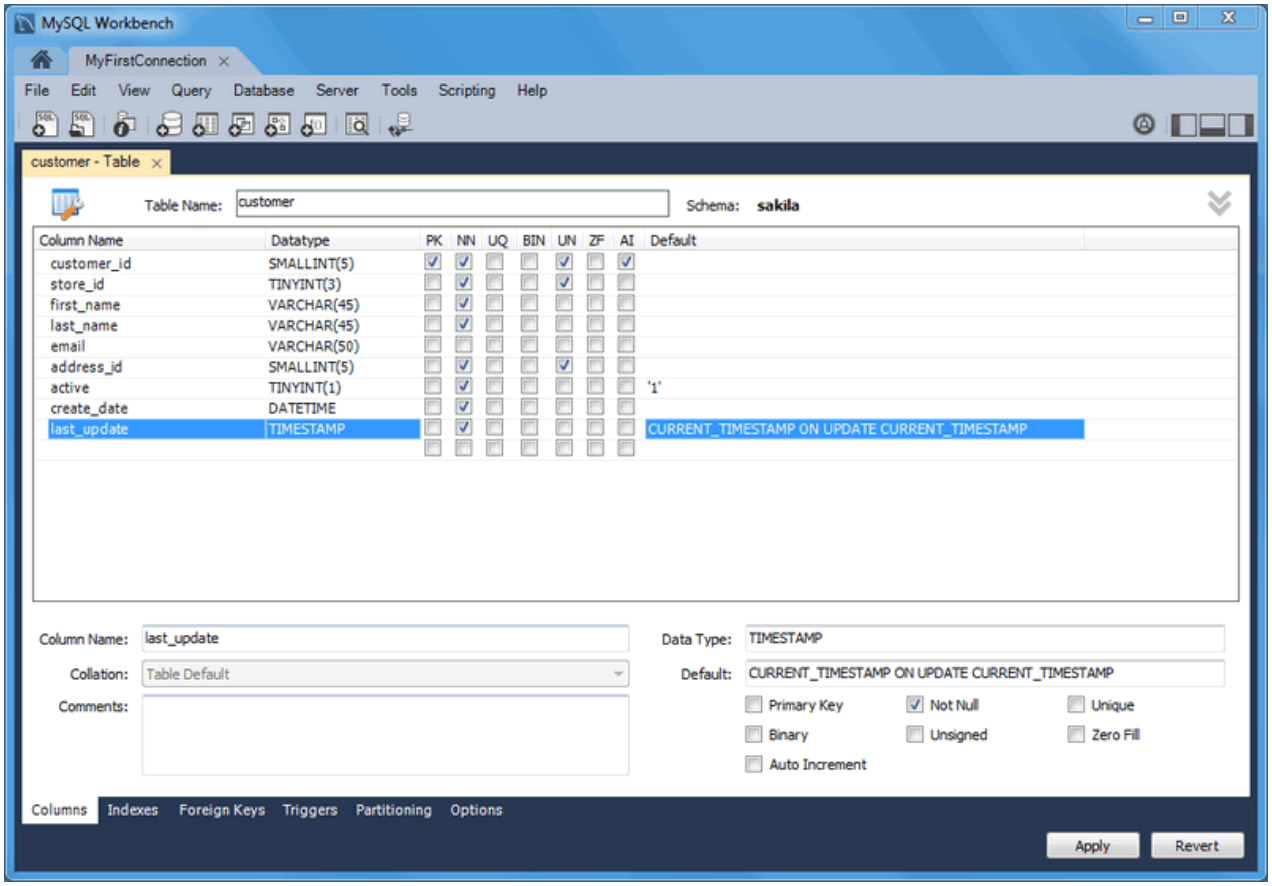
- Columns: Add or modify columns
- Indexes: Add or modify indexes
- Foreign Keys: Add or modify foreign keys
- Triggers: Add or modify triggers
- Partitioning: Manage partitioning
- Options: Add or modify other options, divided in categories named general, row, storage, and merge

8.1.11.2 The Columns Tab

Use the **Columns** tab to display and edit all the column information for a table. With this tab, you can add, drop, and alter columns.

You can also use the **Columns** tab to change column properties such as name, data type, and default value.

Figure 8.18 The Columns Tab



Right-click a row under the `Column Name` column to open a pop-up menu with the following items:

- Move Up: Move the selected column up.
- Move Down: Move the selected column down.
- Copy: Copies the column for a model.
- Cut: Copies and then deletes the column for a model.
- Paste: Pastes the column. If a column with the same name already exists, then `_copy1` is appended to the column name.
- Delete Selected Columns: Select multiple contiguous columns by right-clicking and pressing the **Shift** key. Use the **Control** key to select separated columns.
- Refresh: Update all information in the **Columns** tab.
- Clear Default: Clear the assigned default value.
- Default NULL: Set the column default value to `NULL`.
- Default 0: Set the column default value to `0`.

- Default CURRENT_TIMESTAMP: Available for `TIMESTAMP` data types.
- Default CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP: Available for `TIMESTAMP` data types.

To add a column, click the `Column Name` field in an empty row and enter an appropriate value. Select a data type from the **Datatype** list. Select the column property check boxes as required according to the list of column properties below, and also read the CREATE TABLE documentation for information about what these options mean.

- **PK**: PRIMARY KEY
- **NN**: NOT NULL
- **UQ**: UNIQUE INDEX
- **BIN**: BINARY
- **UN**: UNSIGNED
- **ZF**: ZEROFILL
- **AI**: AUTO_INCREMENT

To change the name, data type, default value, or comment of a column, double-click the value to edit it.

You can also add column comments to the `Column Comment` field. It is also possible to set the column collation, using the list in the **Column Details** panel.

To the left of the column name is an icon that indicates whether the column is a member of the primary key. If the icon is a small key, that column belongs to the primary key, otherwise the icon is a blue diamond or a white diamond. A blue diamond indicates the column has **NN** set. To add or remove a column from the primary key, double-click the icon. You can also add a primary key by checking the `PRIMARY KEY` check box in the `Column Details` section of the table editor.

If you wish to create a composite primary key you can select multiple columns and check the PK check box. However, there is an additional step that is required, you must click the Indexes tab, then in the Index Columns panel you must set the desired order of the primary keys.

Note

When entering default values, in the case of `CHAR` and `VARCHAR` data types MySQL Workbench will attempt to automatically add quotation marks, if the user does not start their entry with one. For other data types the user must manage quoting if required, as it will not be handled automatically by MySQL Workbench.

Caution

Care must be taken when entering a default value for `ENUM` columns because a non-numeric default will not be automatically quoted. You must manually add single quote characters for the default value. Note that MySQL Workbench will **not** prevent you from entering the default value without the single quotation marks. If a non-numeric default value is entered without quotation marks, this will lead to errors. For example, if the model is reverse engineered, the script will contain unquoted default values for `ENUM` columns and will fail if an attempt is made to run the script on MySQL Server.

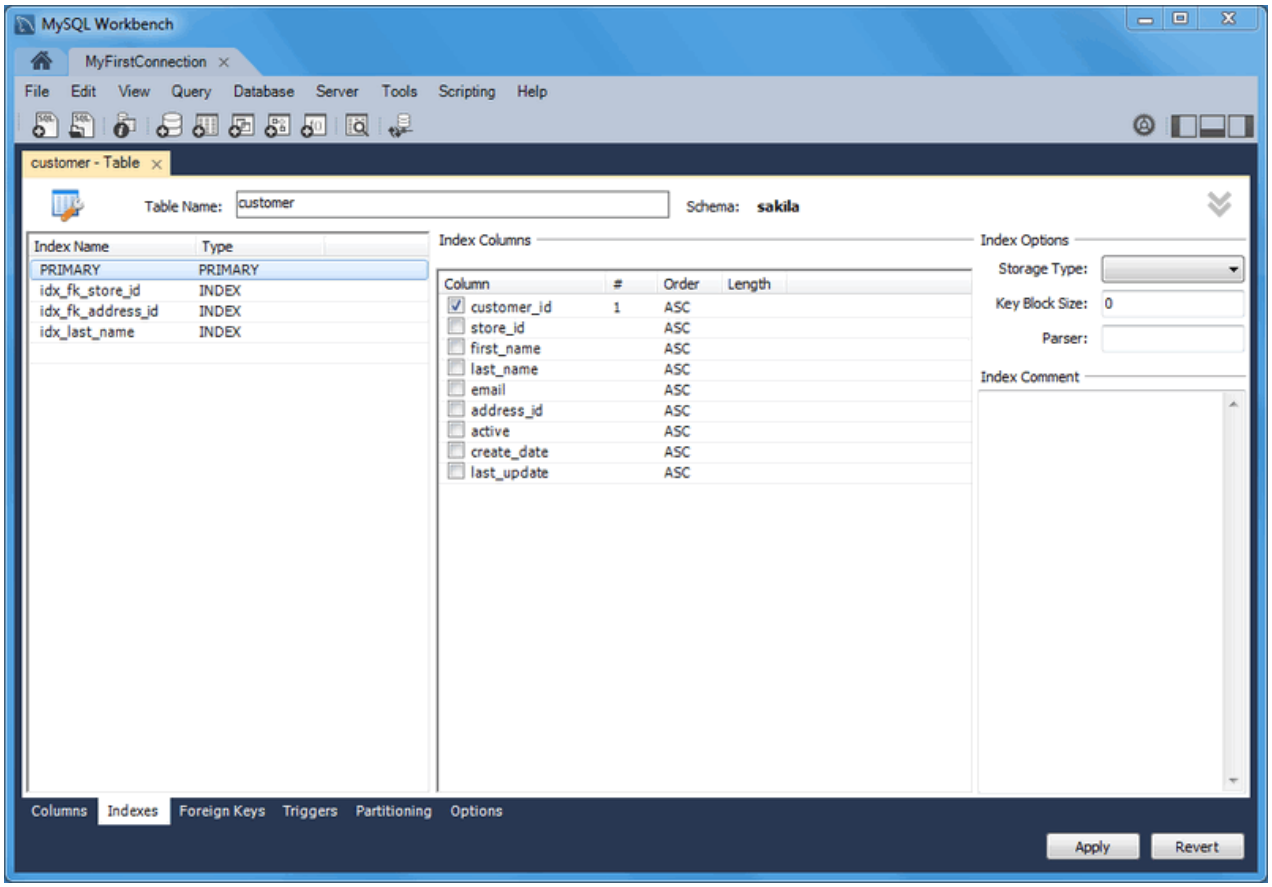
Note

ENUM, BIT, and SET must contain at least one value when entering these data types into MySQL Workbench.

8.1.11.3 The Indexes Tab

The **Indexes** tab holds all index information for your table. Use this tab to add, drop, and modify indexes.

Figure 8.19 The Indexes Tab



Select an index by right-clicking it. The **Index Columns** section displays information about the selected index.

To add an index, click the last row in the index list. Enter a name for the index and select the index type from the list. Select the column or columns that you wish to index by checking the column name in the **Index Columns** list. You can remove a column from the index by removing the check mark from the appropriate column.

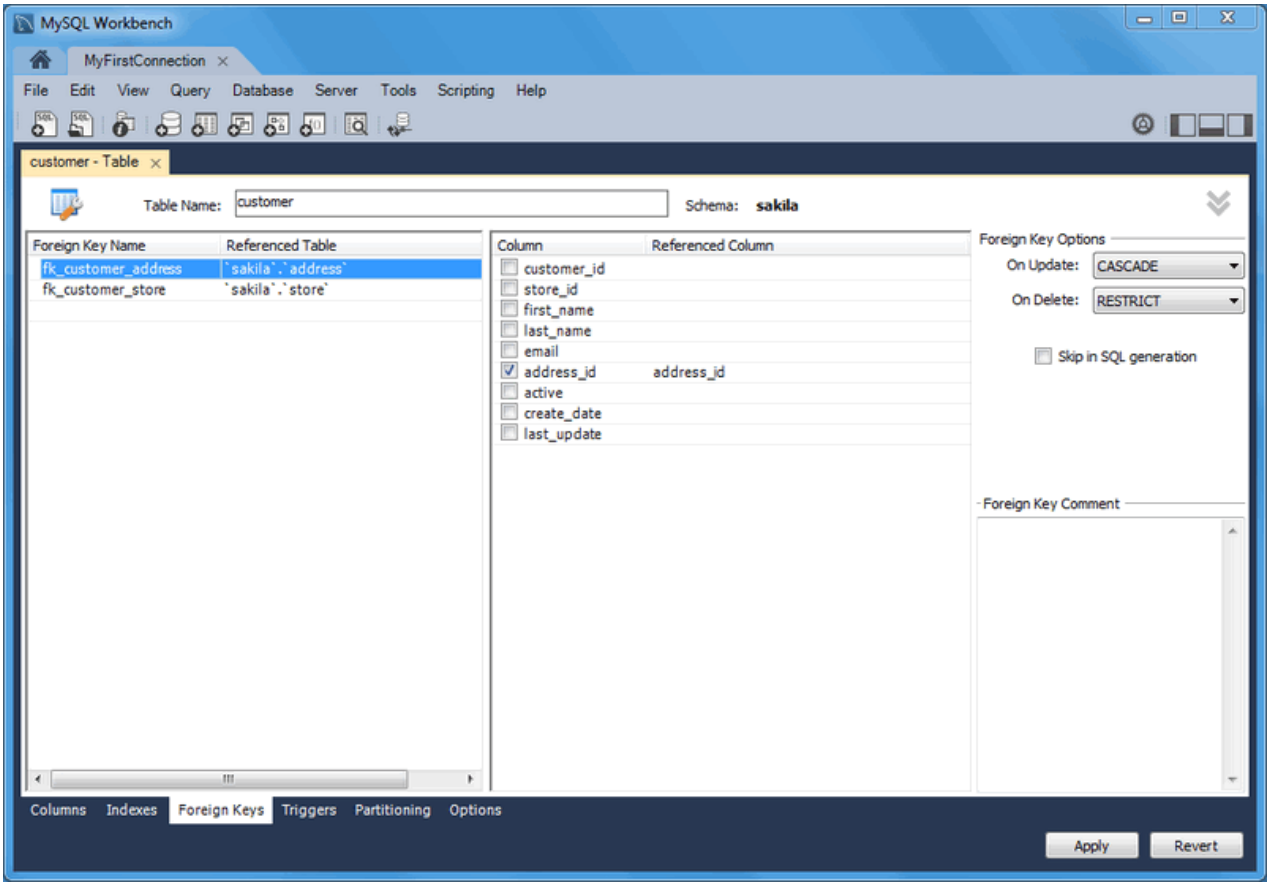
You can also specify the order of an index by choosing `ASC` or `DESC` under the `Order` column. Create an index prefix by specifying a numeric value under the `Length` column. You cannot enter a prefix value for fields that have a data type that does not support prefixing.

To drop an index, right-click the row of the index you wish to delete, then select the Delete Selected Indexes menu item.

8.1.11.4 The Foreign Keys Tab

The **Foreign Keys** tab is organized in much the same fashion as the **Indexes** tab and adding or editing a foreign key is similar to adding or editing an index.

Figure 8.20 The Foreign Keys Tab



To add a foreign key, click the last row in the `Foreign Key Name` list. Enter a name for the foreign key and select the column or columns that you wish to index by checking the column name in the **Column** list. You can remove a column from the index by removing the check mark from the appropriate column.

Under **Foreign Key Options**, choose an action for the update and delete events. The options are:

- RESTRICT
- CASCADE
- SET NULL
- NO ACTION

To drop a foreign key, right-click the row you wish to delete, then select the Delete Selected FKs menu item.

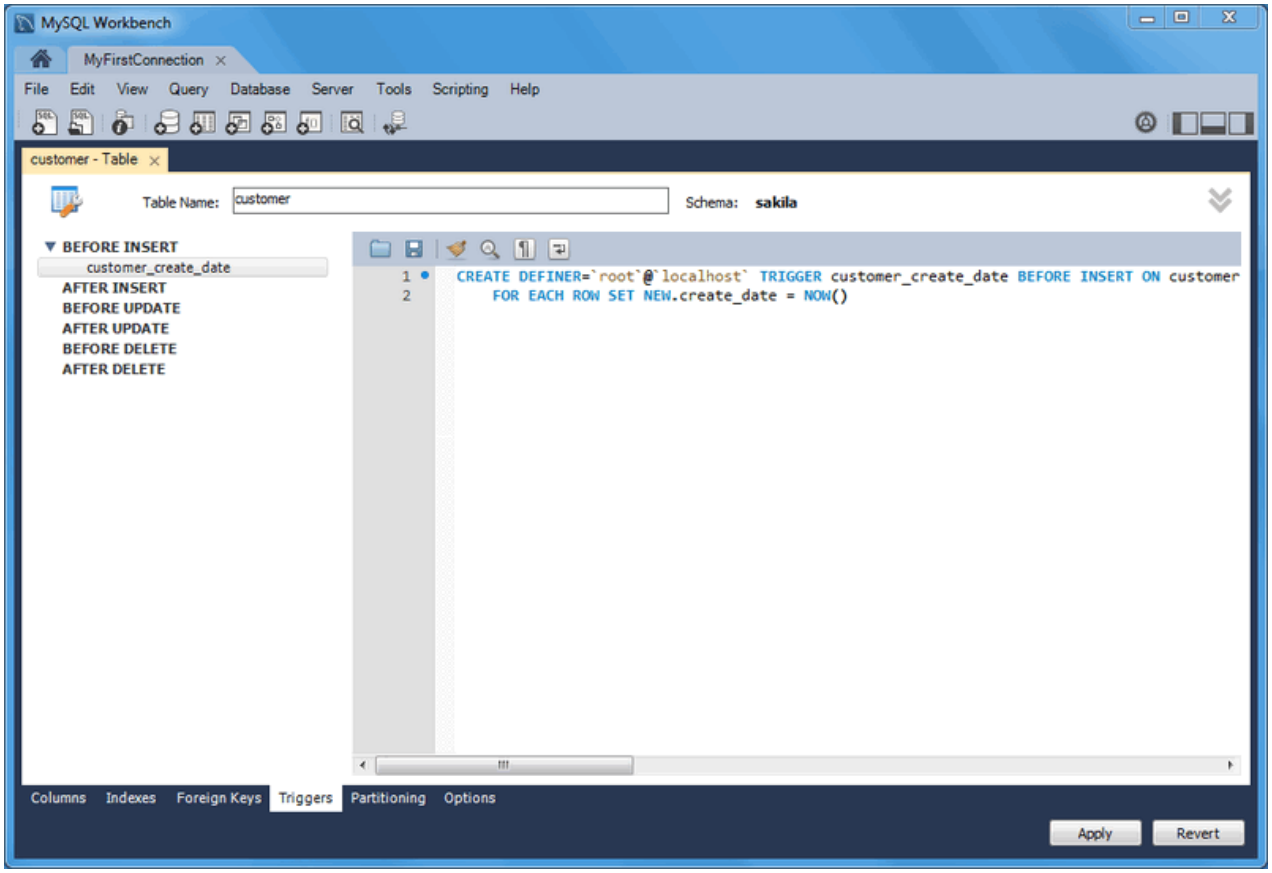
To modify properties of a foreign key, select it and make the desired changes.

8.1.11.5 The Triggers Tab

The **Triggers** tab opens a textbox to create or edit existing triggers.

To add a new trigger, click the **[+]** icon next to the trigger section. To delete a trigger, click the associated **[-]** icon. These icons become visible by hovering over a trigger or trigger section. Click Apply to commit your changes.

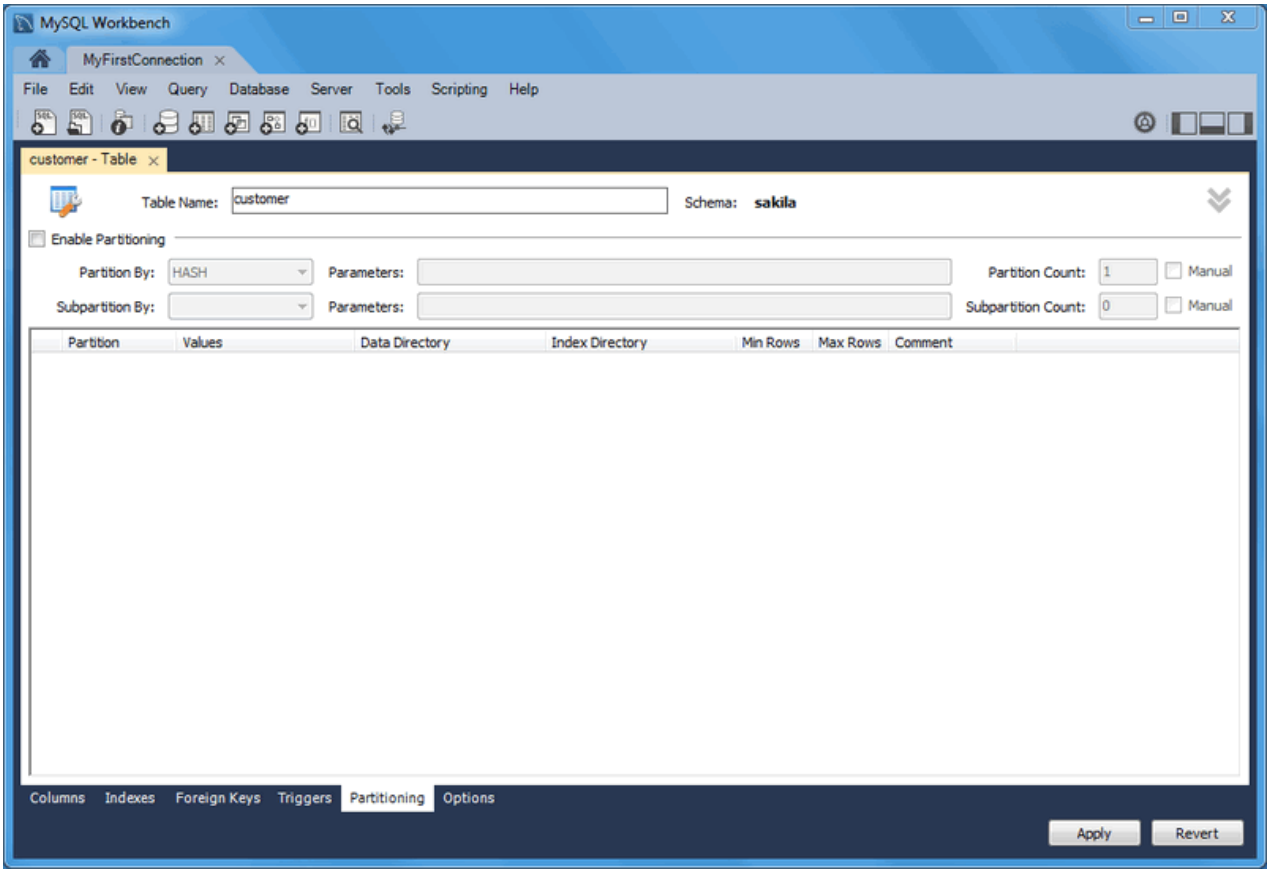
Figure 8.21 The Triggers Tab



8.1.11.6 The Partitioning Tab

To enable partitioning for your table, check the **Enable Partitioning** check box. This enables the partitioning options.

Figure 8.22 The Partitioning Tab



The Partition By pop-up menu displays the types of partitions you can create:

- HASH
- LINEAR HASH
- KEY
- LINEAR KEY
- RANGE
- LIST

Use the **Parameters** field to define any parameters to be supplied to the partitioning function, such as an integer column value.

Choose the number of partitions from the **Partition Count** list. To manually configure your partitions, check the **Manual** check box. This enables entry of values into the partition configuration table. The entries in this table are:

- `Partition`
- `Values`
- `Data Directory`

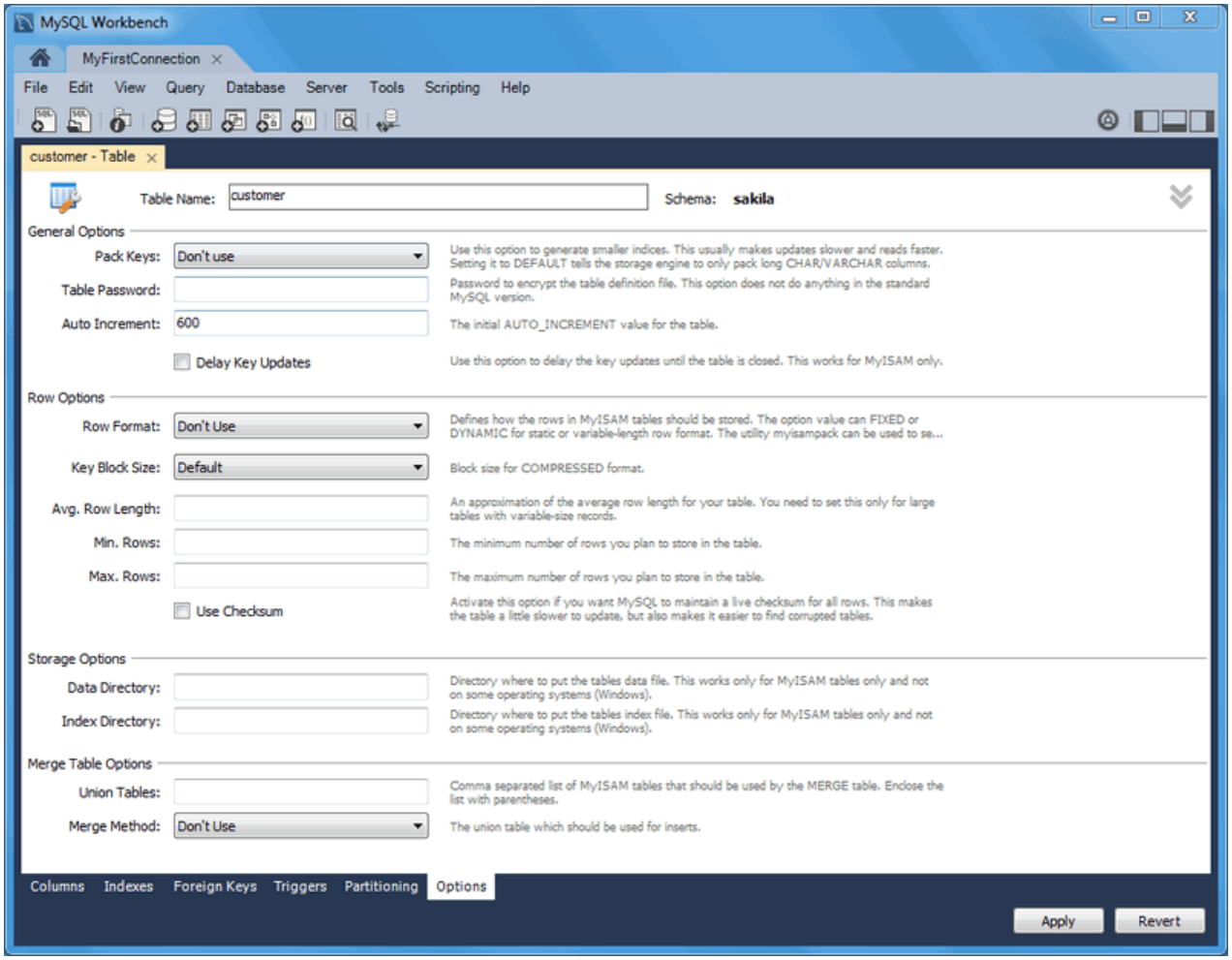
- `Index Directory`
- `Min Rows`
- `Max Rows`
- `Comment`

Subpartitioning is also available. For more information about partitioning, see Partitioning.

8.1.11.7 The Options Tab

The **Options** tab enables you to set several types of options.

Figure 8.23 The Options Tab


MySQL Workbench
MyFirstConnection
File Edit View Query Database Server Tools Scripting Help
customer - Table
Table Name: customer
Schema: sakila
General Options
Pack Keys: Don't use
Use this option to generate smaller indices. This usually makes updates slower and reads faster. Setting it to DEFAULT tells the storage engine to only pack long CHAR/VARCHAR columns.
Table Password:
Password to encrypt the table definition file. This option does not do anything in the standard MySQL version.
Auto Increment: 600
The initial AUTO_INCREMENT value for the table.
Delay Key Updates
Use this option to delay the key updates until the table is closed. This works for MyISAM only.
Row Options
Row Format: Don't Use
Defines how the rows in MyISAM tables should be stored. The option value can FIXED or DYNAMIC for static or variable-length row format. The utility myisampack can be used to se...
Key Block Size: Default
Block size for COMPRESSED format.
Avg. Row Length:
An approximation of the average row length for your table. You need to set this only for large tables with variable-size records.
Min. Rows:
The minimum number of rows you plan to store in the table.
Max. Rows:
The maximum number of rows you plan to store in the table.
Use Checksum
Activate this option if you want MySQL to maintain a live checksum for all rows. This makes the table a little slower to update, but also makes it easier to find corrupted tables.
Storage Options
Data Directory:
Directory where to put the tables data file. This works only for MyISAM tables only and not on some operating systems (Windows).
Index Directory:
Directory where to put the tables index file. This works only for MyISAM tables only and not on some operating systems (Windows).
Merge Table Options
Union Tables:
Comma separated list of MyISAM tables that should be used by the MERGE table. Enclose the list with parentheses.
Merge Method: Don't Use
The union table which should be used for inserts.
Columns Indexes Foreign Keys Triggers Partitioning Options
Apply
Revert

which are grouped into the following sections:

- General Options
- Row Options
- Storage Options

- Merge Table options

The following discussion describes these options in more detail.

General Options Section

In the **General Options** section, choose a pack keys option. The options are `Default`, `Pack None`, and `Pack All`. You may also encrypt the definition of a table. The `AUTO_INCREMENT` and delayed key update behaviors apply only to `MyISAM` tables.

Row Options Section

To set the row format, choose the desired row format from the list. For more information about the different row formats that are available, see MyISAM Table Storage Formats.

These options are:

- Default
- Dynamic
- Fixed
- Compressed
- Redundant
- Compact

When you expect a table to be particularly large, use the **Avg. Row**, **Min. Rows**, and **Max. Rows** options to enable the MySQL server to better accommodate your data. See CREATE TABLE Syntax for more information on how to use these options.

Storage Options Section

The `Storage Options` section is available only for `MyISAM` tables. Use it to configure a custom path to the table storage and data files. This can help improve server performance by locating different tables on different hard drives.

Merge Table Options Section

Use the `Merge Table` Options section to configure `MERGE` tables. To create a `MERGE` table, select `MERGE` as your storage engine and then specify the `MyISAM` tables you wish to merge in the **Union Tables** dialog.

You may specify the action the server should take when users attempt to perform `INSERT` statements on the merge table. You may also select the `Merge Method` by selecting from the list. For more information about `MERGE` tables, see The MERGE Storage Engine.

8.1.12 Code Generation Overview

This document provides a quick hands-on introduction to using MySQL Workbench to generate code for later use, for either in or outside of MySQL Workbench.

8.1.12.1 Generating SQL Statements

MySQL Workbench can be used to generate SQL, most typically as either `INSERT` statements or `SELECT` statements.

Below are common methods for generating SQL statements in MySQL Workbench.

Note

All of the MySQL Workbench Export options include the option to export as SQL.

Context-menu options after right-clicking on a `schema` in the schema view, using the `sakila` column as an example:

Create Statement

```
CREATE DATABASE `sakila` /*!40100 DEFAULT CHARACTER SET latin1 */;
```

Name

```
`sakila`
```

Context-menu options after right-clicking on a `table` in the schema view, using the `sakila.actor` column as an example:

Name (Short)

```
`actor`
```

Name (Long)

```
`sakila`.`actor`
```

Select All Statement

```
SELECT `actor`.`actor_id`,
    `actor`.`first_name`,
    `actor`.`last_name`,
    `actor`.`last_update`
FROM `sakila`.`actor`;
```

Select with References

```
SET @actor_id_to_select = <{row_id}>;
SELECT film_actor.*
    FROM film_actor, actor
    WHERE `actor`.`actor_id` = `film_actor`.`actor_id`
          AND actor.actor_id = @actor_id_to_select;
SELECT actor.*
    FROM actor
```

```
    WHERE actor.actor_id = @actor_id_to_select;
```

Insert Statement

```
INSERT INTO `sakila`.`actor`
  (`actor_id`,
  `first_name`,
  `last_name`,
  `last_update`)
VALUES
  (<{actor_id: }>,
  <{first_name: }>,
  <{last_name: }>,
  <{last_update: CURRENT_TIMESTAMP}>);
```

Update Statement

```
UPDATE `sakila`.`actor`
SET
`actor_id` = <{actor_id: }>,
`first_name` = <{first_name: }>,
`last_name` = <{last_name: }>,
`last_update` = <{last_update: CURRENT_TIMESTAMP}>
WHERE `actor_id` = <{expr}>;
```

Delete Statement

```
DELETE FROM `sakila`.`actor`
WHERE <{where_expression}>;
```

Delete with References

```
-- All objects that reference that row (directly or indirectly)
-- will be deleted when this snippet is executed.
-- To preview the rows to be deleted, use Select Row Dependencies
START TRANSACTION;
-- Provide the values of the primary key of the row to delete.
SET @actor_id_to_delete = <{row_id}>;

DELETE FROM film_actor
    USING film_actor, actor
    WHERE `actor`.`actor_id` = `film_actor`.`actor_id`
          AND actor.actor_id = @actor_id_to_delete;
DELETE FROM actor
    USING actor
    WHERE actor.actor_id = @actor_id_to_delete;
COMMIT;
```

Create Statement

```
CREATE TABLE `actor` (
  `actor_id` smallint(5) unsigned NOT NULL AUTO_INCREMENT,
  `first_name` varchar(45) NOT NULL,
  `last_name` varchar(45) NOT NULL,
  `last_update` timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  PRIMARY KEY (`actor_id`),
  KEY `idx_actor_last_name` (`last_name`)
) ENGINE=InnoDB AUTO_INCREMENT=201 DEFAULT CHARSET=utf8;
```

Context-menu options after right-clicking on a `column` in the schema view, using the `sakila.actor.first_name` column as an example:

Name (short)

```
`first_name`
```

Name (long)

```
`actor`.`first_name`
```

Select Columns Statement

```
SELECT `first_name` FROM `sakila`.`actor`;
```

Insert Statement

```
INSERT INTO `sakila`.`actor`
(`first_name`)
VALUES
(<{first_name}>);
```

Update Statement

```
UPDATE `sakila`.`actor`
SET
`first_name` = <{first_name}>
WHERE <{where_expression}>;
```

Context-menu options after right-clicking on a `field` in the results view, using record #1 in the `sakila.actor` table as an example:

Copy Rows (with names)

```
# actor_id, first_name, last_name, last_update
'1', 'PENELOPE', 'GUINESS', '2006-02-15 04:34:33'
```

```
```

Copy Rows (with names, unquoted)

```
# actor_id, first_name, last_name, last_update
1, PENELOPE, GUINESS, 2006-02-15 04:34:33
```

Copy Row (tab separated)

```
1 PENELOPE GUINESS 2006-02-15 04:34:33
```

Copy Field

```
'GUINESS'
```

8.1.12.2 Generating PHP Code

MySQL Workbench can be used to generate PHP code with the bundled PHP plugin, by using the Tools, Utilities, Copy as PHP Code menu option.

Below is an example scenario for how to create PHP code. It is a `SELECT` statement, and optionally uses `SET` to set variables.

SQL @variables generate PHP variables in the code that then bind to the statement before execution.

1. Generate or type in the desired SQL query into the SQL editor. This example will use the `sakila` database, with the query being:

   ```
   SET @last_update = '2006-02-14';

   SELECT  actor_id, first_name, last_name, last_update
     FROM  actor
     WHERE last_update > @last_update;
   ```

2. While in the SQL editor, choose Tools, Utilities, Copy as PHP Code (Iterate SELECT Results) from the main menu. This will copy PHP code to the clipboard.

3. Paste the code to the desired location.

Additionally, PHP code that connects to the MySQL database can also be generated by choosing Tools, Utilities, Copy as PHP Code (Connect to Server).

After combining the two, the generated PHP code will look like this:

```
<?php

$host     = "localhost";
$port     = 3306;
$socket   = "";
```

```
$user     = "nobody";
$password = "";
$dbname   = "sakila";

$con = new mysqli($host, $user, $password, $dbname, $port, $socket)
    or die ('Could not connect to the database server' . mysqli_connect_error());

//$con->close();

$query = "SELECT actor_id, first_name, last_name, last_update
          FROM   actor
          WHERE  last_update > ?";
$last_update = '';

$stmt->bind_param('s', $last_update);

if ($stmt = $con->prepare($query)) {

    $stmt->execute();
    $stmt->bind_result($actor_id, $first_name, $last_name, $last_update);

    while ($stmt->fetch()) {
        // printf("%s, %s, %s, %s\n",
        //   $actor_id, $first_name, $last_name, $last_update);
    }

    $stmt->close();
}

?>
```

Note

The generated PHP code uses the `mysqli` PHP extension for MySQL. This extension must be enabled in your PHP distribution for this code to work. For additional details about this PHP extension, see MySQL Improved Extension.

8.2 Object Management

The Object Browser allows you to navigate database schemas and objects. From here, you can perform common tasks such as selecting tables and fields to query, edit tables, create new or drop tables and databases, perform searches, and more.

8.2.1 Object Browser and Editor Navigator

The Navigator contains options to manage the active MySQL connection, and also lists the schemas available to that connection.

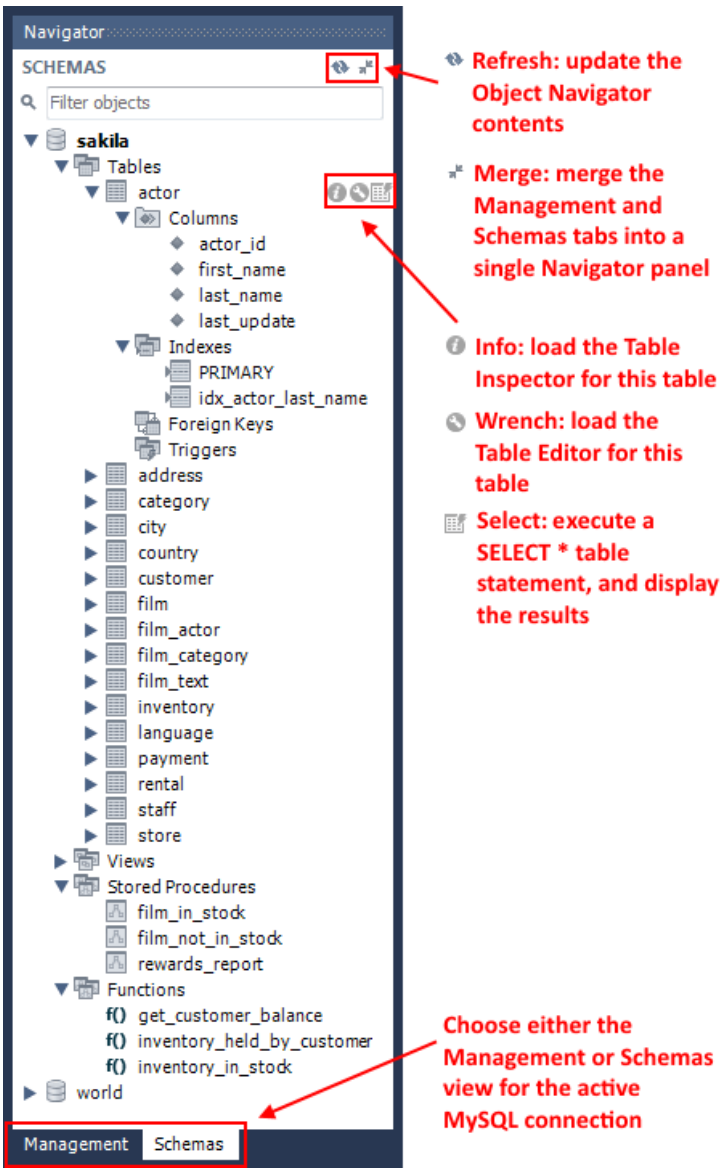
Navigator Schemas Tab

The Schemata list shows available schemata on the currently connected server. These can be explored to show tables, views, and routines within the schema.

Note

Internal schemas, such as "performance_schema", "information"schema", "sys", and "mysql", are hidden by default. Toggle the **Show Metadata and Internal Schemas** preference to list them in the object browser. Schemas beginning with a "." are also controlled by this setting.

Figure 8.24 SQL Editor - Navigator Schemas Tab



It is possible to set a schema as the default schema by right-clicking the schema and selecting the Set As Default Schema menu item. This executes a `USE schema_name` statement so that subsequent statements without schema qualifiers are executed against this schema. This setting applies only to the query session. To set a default schema for multiple MySQL Workbench sessions, you must set the default schema for the stored connection. From the Home screen, right-click on a MySQL connection, choose Edit Connection, and set the desired default schema on the **Default Schema** box.

Note

The selected schema is displayed as `bold` in the Schema navigator.

Double-clicking a table, view, or column name in the schemata explorer inserts the name into the SQL Query area. This reduces typing significantly when entering SQL statements containing references to several tables, views, or columns.

The Schema Navigator also features a context menu which can be displayed by right-clicking an object. For example, right-clicking a table displays the following menu items:

- Select Rows - Limit 1000: Pulls up to 1000 rows of table data from the live server into a Results tabsheet, and enables editing. Data can be saved directly to the live server.
- Table Inspector: Displays table information, similar to the `Schema Inspector`. This also has a simpler and easier to use interface for analyzing and creating indexes for tables.
- Table Data Export: Opens the table export wizard to export the table's data to JSON or customized CSV.
- Table Data Import: Opens the table import wizard to import JSON or CSV formatted data to the selected or new table.
- Copy to Clipboard: There are various submenus, each of which copies information to the clipboard:
  - Name (short): Copies the table name.
  - Name (long): Copies the qualified table name in the form `` `schema`.`table` ``.
  - Select All Statement: Copies a statement to select all columns in this form:

    ```
    SELECT
    `table`.`column1`,
    `table`.`column2`,
    ...
    FROM `schema`.`table`;
    ```

  - Insert Statement: Copies an `INSERT` statement to insert all columns.
  - Update Statement: Copies an `UPDATE` statement to update all columns.
  - Delete Statement: Copies a `DELETE` statement in the form `DELETE FROM `world`.`country` WHERE <{where_condition}>;`.
  - Create Statement: Copies a `CREATE` statement in the form `DELETE FROM `world`.`country` WHERE <{where_condition}>;`.
  - Delete with References: Copies a `DELETE` statement, in the form of a transaction, that deletes all objects that reference the row (directly or indirectly).

    Use Select with References first to preview this operation.
  - Select with References: Copies a `SELECT` statement that selects all objects that reference the row (directly or indirectly).

    Use Delete with References to generate a DELETE statement for this operation.
- Send to SQL Editor: Provides functionality similar to Copy to Clipboard. However, this item inserts the SQL code directly into the SQL Query panel, where it can be edited further as required.
- Create Table: Launches a dialog to enable you to create a new table.
- Create Table Like...: Launches a dialog to enable you to create a new table, and to also apply predefined templates. For additional information, see Section 9.6, “Table Templates”.
- Alter Table...: Displays the table editor loaded with the details of the table.

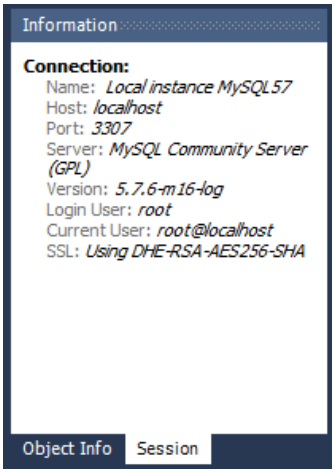
- Table Maintenance: Opens a new tab for performing table maintenance operations. Operations include "Analyze Table", "Optimize Table", "Check Table", and "Checksum Table". Additional information about the table may also be viewed from this tab. For additional information, see Schema Inspector.
- Drop Table...: Drops the table. All data in the table will be lost if this operation is carried out.
- Truncate Table...: Truncates the table.
- Search Table Data...: Opens a new tab for performing table searches. It performs a search on all columns, and offers additional options to limit the search.
- Refresh All: Refreshes all schemata in the explorer by resynchronizing with the server.

Right-clicking on a schema provides similar options to the table context menu described above, but the operations refer to the Schema. For example, the **Table Maintenance** in the table context menu selects the table in the **Schema Inspector**, which is a schema context menu option.

8.2.2 Session and Object Information Panel

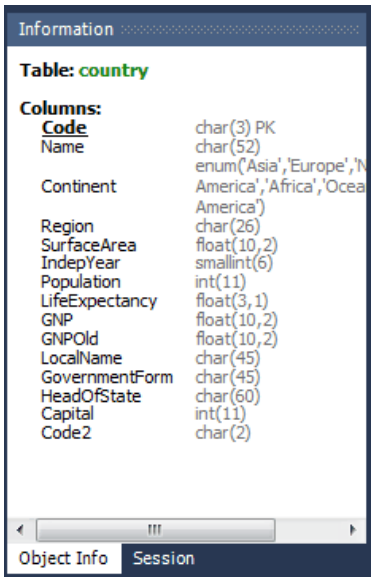
This panel summarizes the current connection to the server.

Figure 8.25 SQL Editor - Connection Information Palette



This panel also summarizes information about the object.

Figure 8.26 SQL Editor - Object Info



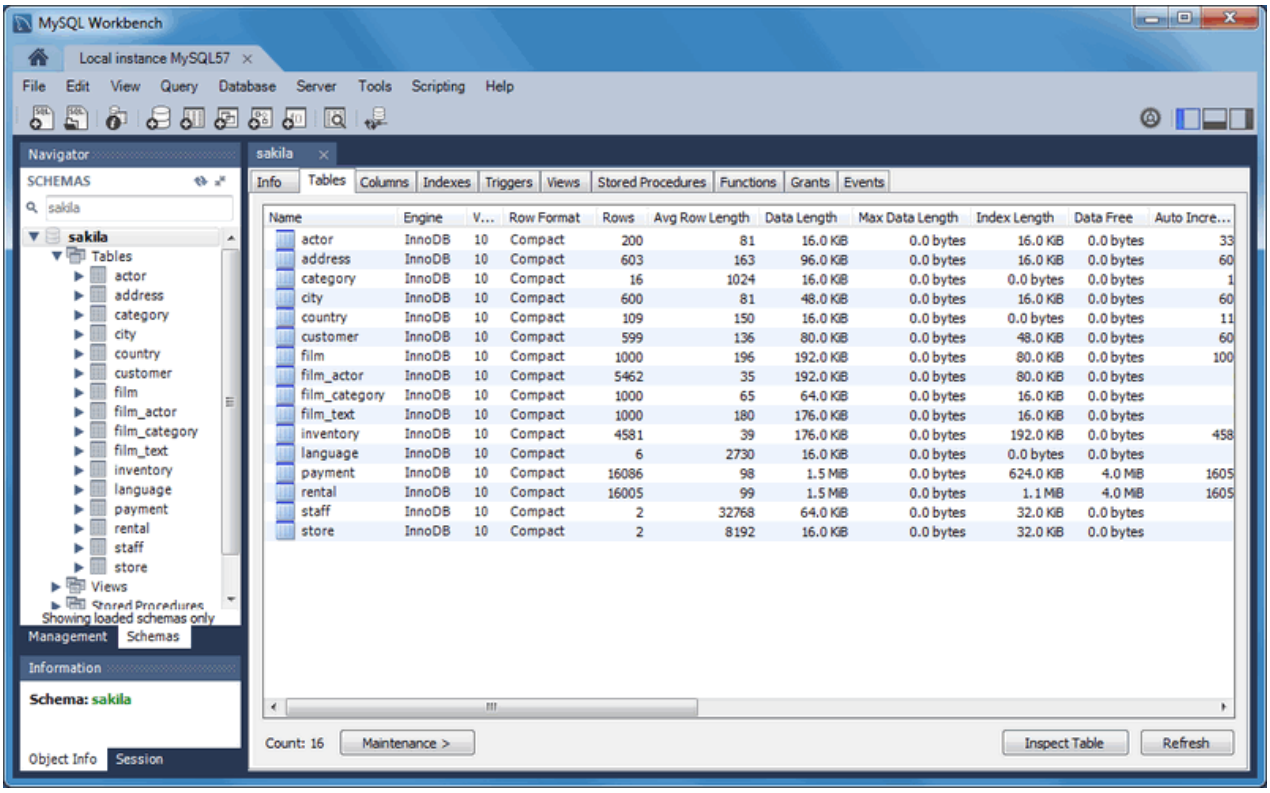
8.2.3 Schema and Table Inspector

The Schema and Table Inspector includes the ability to analyze and repair tables, and also view table metrics.

Schema Inspector

Use the Schema Inspector to browse general information from schema objects. It allows you to perform maintenance tasks on tables such as ANALYZE, OPTIMIZE, CHECK, and CHECKSUM TABLE. To access the inspector, right-click on a schema and select the Schema Inspector

Figure 8.27 Schema Inspector


MySQL Workbench
Local instance MySQL57
File Edit View Query Database Server Tools Scripting Help
Navigator
SCHEMAS
sakila
Tables
actor
address
category
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customer
film
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language
payment
rental
staff
store
Views
Stored Procedures
Showing loaded schemas only
Management Schemas
Information
Schema: sakila
Object Info Session
sakila
Info Tables Columns Indexes Triggers Views Stored Procedures Functions Grants Events
Name Engine V... Row Format Rows Avg Row Length Data Length Max Data Length Index Length Data Free Auto Incre...
actor InnoDB 10 Compact 200 81 16.0 KiB 0.0 bytes 16.0 KiB 0.0 bytes 33
address InnoDB 10 Compact 603 163 96.0 KiB 0.0 bytes 16.0 KiB 0.0 bytes 60
category InnoDB 10 Compact 16 1024 16.0 KiB 0.0 bytes 0.0 bytes 0.0 bytes 1
city InnoDB 10 Compact 600 81 48.0 KiB 0.0 bytes 16.0 KiB 0.0 bytes 60
country InnoDB 10 Compact 109 150 16.0 KiB 0.0 bytes 0.0 bytes 0.0 bytes 11
customer InnoDB 10 Compact 599 136 80.0 KiB 0.0 bytes 48.0 KiB 0.0 bytes 60
film InnoDB 10 Compact 1000 196 192.0 KiB 0.0 bytes 80.0 KiB 0.0 bytes 100
film_actor InnoDB 10 Compact 5462 35 192.0 KiB 0.0 bytes 80.0 KiB 0.0 bytes
film_category InnoDB 10 Compact 1000 65 64.0 KiB 0.0 bytes 16.0 KiB 0.0 bytes
film_text InnoDB 10 Compact 1000 180 176.0 KiB 0.0 bytes 16.0 KiB 0.0 bytes
inventory InnoDB 10 Compact 4581 39 176.0 KiB 0.0 bytes 192.0 KiB 0.0 bytes 458
language InnoDB 10 Compact 6 2730 16.0 KiB 0.0 bytes 0.0 bytes 0.0 bytes
payment InnoDB 10 Compact 16086 98 1.5 MiB 0.0 bytes 624.0 KiB 4.0 MiB 1605
rental InnoDB 10 Compact 16005 99 1.5 MiB 0.0 bytes 1.1 MiB 4.0 MiB 1605
staff InnoDB 10 Compact 2 32768 64.0 KiB 0.0 bytes 32.0 KiB 0.0 bytes
store InnoDB 10 Compact 2 8192 16.0 KiB 0.0 bytes 32.0 KiB 0.0 bytes
Count: 16
Maintenance >
Inspect Table
Refresh

Each tab lists topic oriented information, such as "Tables", "Indexes", and "Triggers". From the **Tables** tab, click Inspect Table to open the Table Inspector, or Maintenance to open the table maintenance tools:

Figure 8.28 Schema Inspector: Table Maintenance

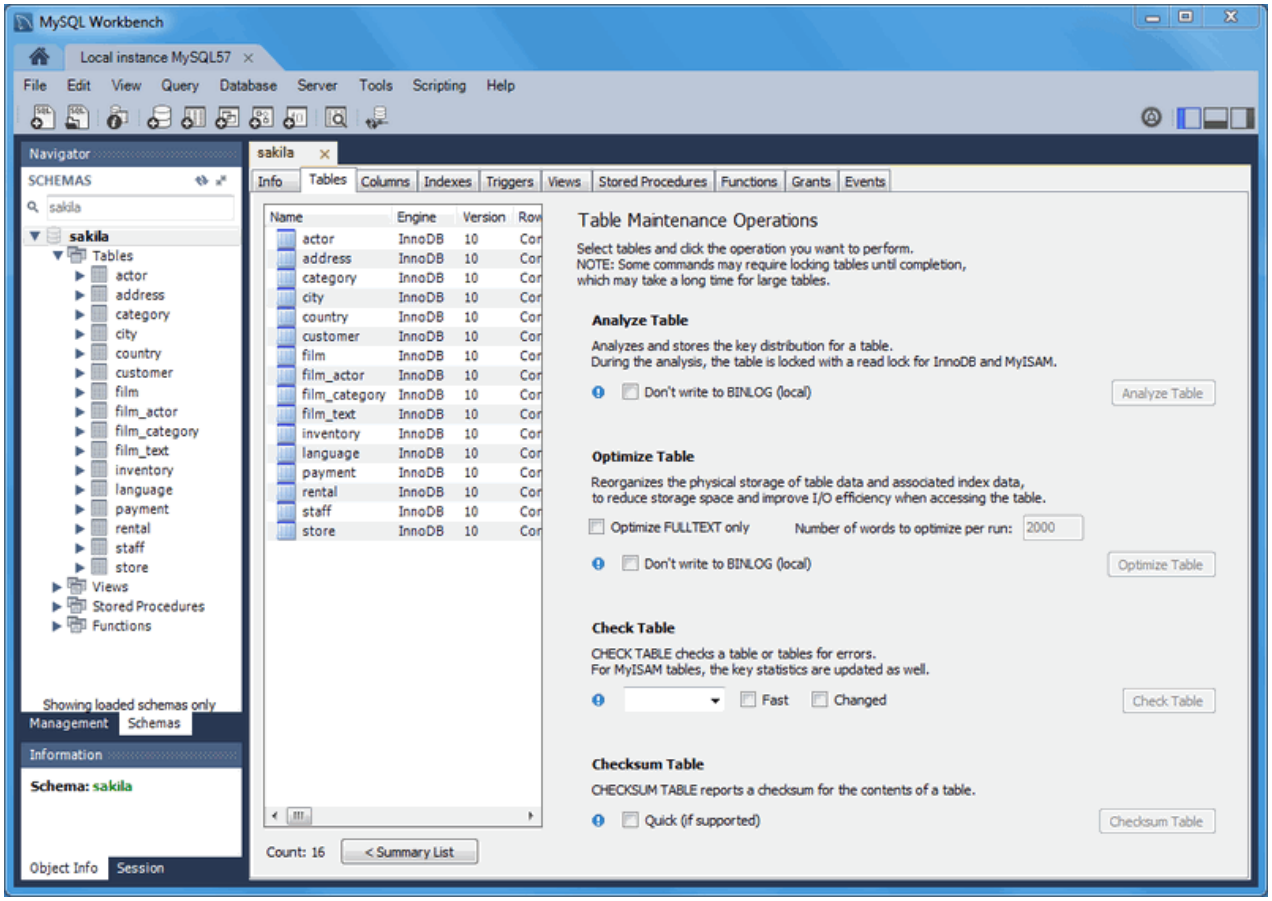


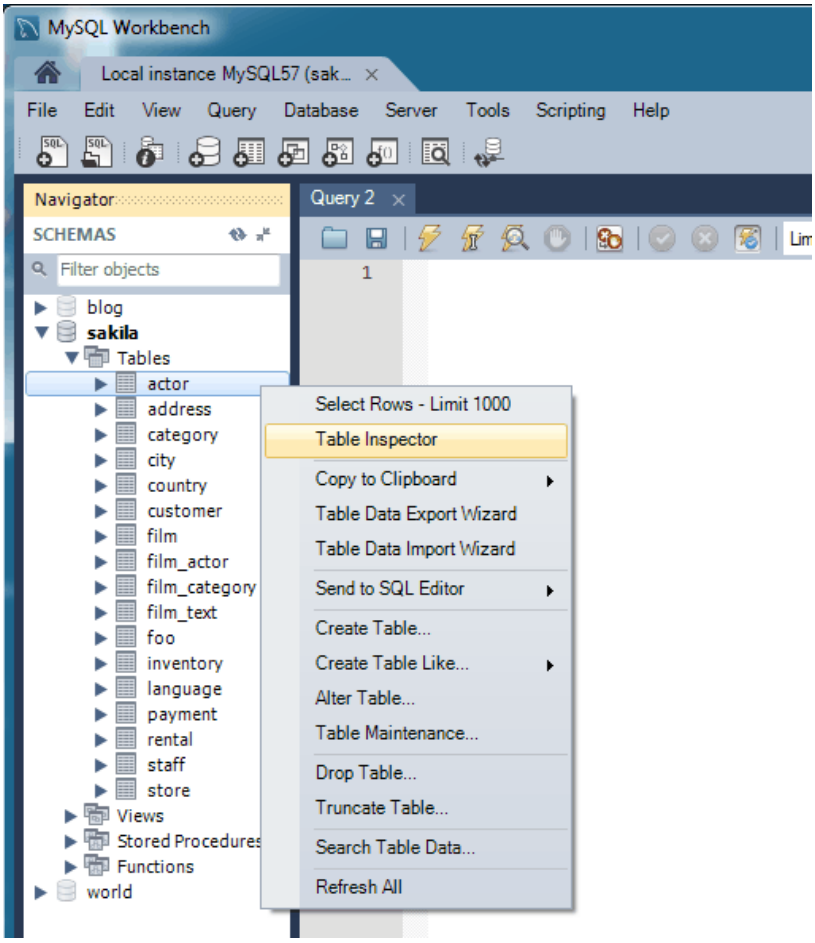
Table Inspector

Table Inspector

View table information, similar to the Schema Inspector. This also has a simpler and easier to use interface for analyzing and creating indexes for your tables.

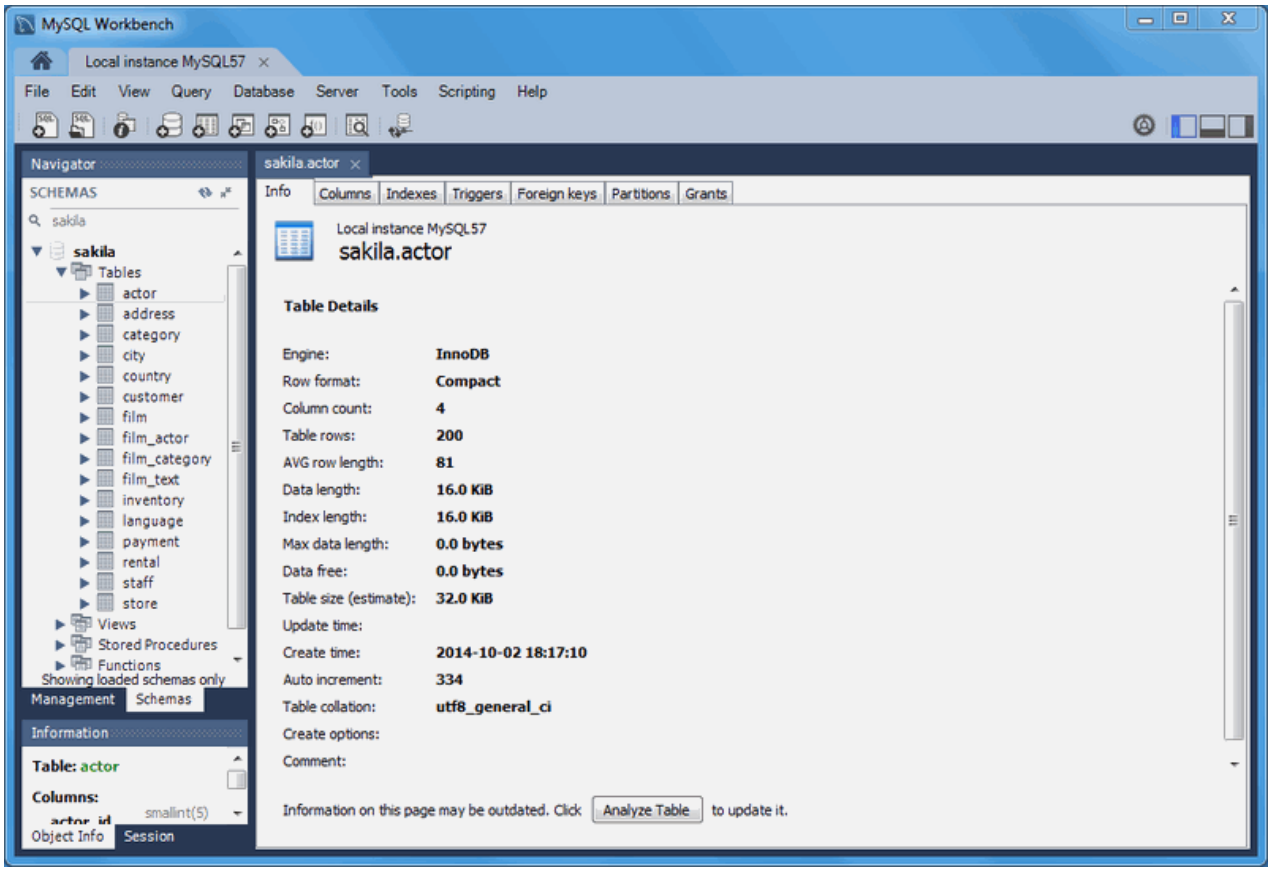
To open, right-click on a table in the object browser and choose Table Inspector from the context menu.

Figure 8.29 Open the Table Inspector



The **Table Inspector** shows information related to the table.

Figure 8.30 Table Inspector: Info Tab



Chapter 9 Database Design / Modeling

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Modeling simplifies database design and maintenance by enabling you, the data architect, to visualize requirements and resolve design issues. Model-driven database design is an efficient methodology for creating valid and well-performing databases, while providing the flexibility to respond to evolving data requirements. Models are used to build ER diagrams and physical MySQL databases.

MySQL Workbench provides extensive capabilities for creating and manipulating database models, including these:

- Create and manipulate a model graphically
- Reverse engineer a live database to a model
- Forward engineer a model to a script or live database
- Create and edit tables and insert data

This is not an exhaustive list. The following sections discuss these and additional data-modeling capabilities.

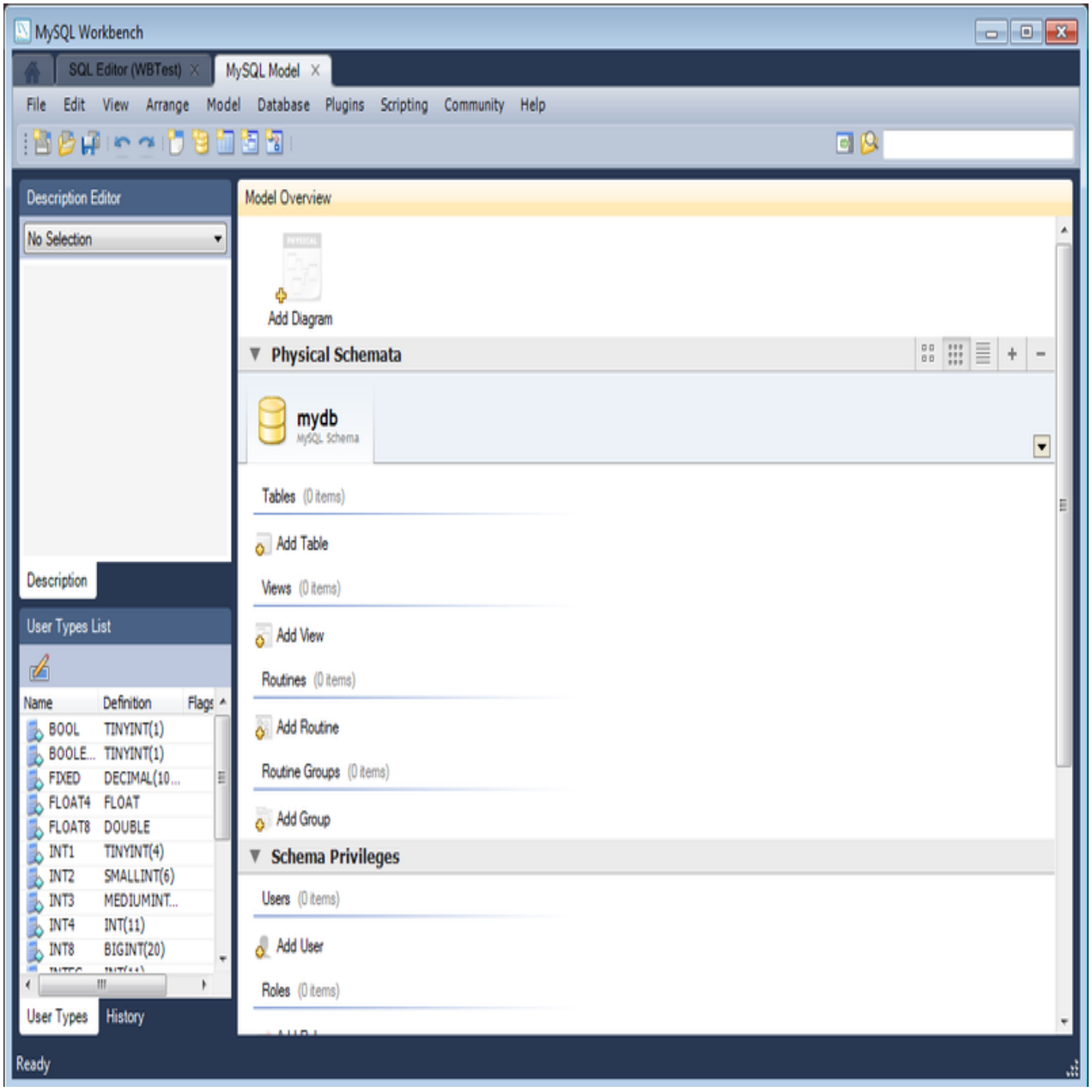
9.1 Modeling Interface

Modeling concepts and interface elements are described below.

9.1.1 Model Editor

When the Model Editor is executed from the Home window, MySQL Workbench displays the MySQL Model page. The MySQL Model page has three main panels, as shown in the following screenshot: Description Editor, User Types List/History panel, and Model Overview.

Figure 9.1 The MySQL Model Page



The Description Editor and User Types List/History panel are contained within the Sidebar. The Sidebar is located on the left by default, but can be relocated to the right using a setting in the Workbench Preferences dialog.

The **Model Overview** panel includes the following sections:

- EER Diagrams
- Physical Schemata
- Schema Privileges
- SQL Scripts
- Model Notes

For each of these sections, add objects to a project by clicking the appropriate add-object icon. You may also rename, edit, cut, copy, or delete objects on this page by right-clicking to open a pop-up menu.

The following sections further discuss the MySQL Model page.

9.1.1.1 Modeling Menus

Some menu items are not available in the MySQL Workbench Community edition of this application, and are available only in the MySQL Workbench commercial editions;. This is indicated where applicable.

The File Menu

Use the File menu to open a project, begin a new project, or save a project. Choosing Model opens the default schema, `mydb`. Choosing Open Model opens a file dialog box with the default file type set to MySQL Workbench Models (`mwb` extension). To display a list of recently opened MWB files, choose the Open Recent menu item. The keyboard shortcut to create a new project is **Control+N** and the command to open an existing project is **Control+O**.

To close the currently active `MySQL Model` or `EER Diagram` tab, use the Close Tab menu item. You can also do this from the keyboard by pressing **Control+W**. To reopen the `MySQL Model` tab, see The View Menu. To reopen an `EER Diagram` tab, double-click the `EER Diagram` icon in the `EER Diagrams` section of the `MySQL Model` page.

Use the Save Model or Save Model As menu items to save a model. When you save a model, its name appears in the title bar of the application. If you have made changes to a project and have not saved those changes, an asterisk appears in the title bar following the model name. When you save a model, it is saved as a MySQL Workbench file with the extension `mwb`.

Use the Import menu item to import a MySQL data definition (DDL) script file. For example, this might be a file created by issuing the command `mysqldump --no-data`. MySQL Workbench handles the script as follows:

- If the script does not contain a `CREATE DATABASE db_name;` statement, the schema objects are copied to the default schema, `mydb`.
- If the script creates a database, a new tab bearing the database name is added to the `Physical Schemata` section of the `MySQL Model` page.
- If the script contains data, the data is ignored.

For details about importing a DDL script, see Section 9.4.2.1, “Reverse Engineering Using a Create Script”.

Under the Import submenu, you can also import `DBDesigner4` files.

There are variety of items under the Export submenu. You may generate the SQL statements necessary to create a new database or alter an existing one. For more information about these menu items, see Section 9.4.1.1, “Forward Engineering Using an SQL Script”.

Using the Export submenu, you can also export an EER diagram as a PNG, SVG, PDF, or Postscript file. For an example of a PNG file, see Figure 9.29, “The sakila Database EER Diagram”.

The Page Setup menu item enables you to set the paper size, orientation, and margins for printing purposes.

The printing options are enabled only if the **EER Diagrams** tab is selected. You have the choice of printing your model directly to your printer, printing it as a PDF file, or creating a PostScript file. For more information, see Section 9.2.1, “Printing Diagrams”.

Note

The printing options are available only in commercial versions of MySQL Workbench.

Use the Document Properties menu item to set the following properties of your project:

- `Name`: The model name (default is `MySQL Model`)
- `Version`: The project version number
- `Author`: The project author
- `Project`: The project name
- `Created`: Not editable; determined by the MWB file attributes
- `Last Changed`: Not editable; determined by the MWB file attributes
- `Description`: A description of your project

The Edit Menu

Use the Edit menu to make changes to objects. The menu item text descriptions change to reflect the name of the selected object.

This menu has items for cutting, copying, and pasting. These actions can also be performed using the **Control+X**, **Control+C**, and **Control+V** key combinations. Undo a deletion using the Undo Delete '*`object_name`*' item. The **Control+Z** key combination can also be used to undo an operation. It is also possible to carry out a Redo operation using either the menu item, or the key combination **Control+Y**.

Also find a Delete '*`object_name`*' menu item for removing the currently selected object. The keyboard command for this action is **Control+Delete**. You can also right-click an object and choose the delete option from the pop-up menu.

The Delete '*`object_name`*' menu item behaves differently depending upon circumstances. For example, if an **EER Diagram** is active and a table on the canvas is the currently selected object, a dialog box may open asking whether you want to remove the table from the canvas only or from the database as well. For information about setting the default behavior when deleting from an EER Diagram, see Section 3.2.4, “Modeling Preferences”.

Warning

If the `MySQL Model` page is active, the selected object is deleted from the catalog and there will be *no confirmation dialog box*.

Choose Edit Selected to edit the currently selected object. You can also perform edits in a new window by selecting Edit Selected in New Window. The keyboard shortcuts for Edit Selected and Edit Selected in New Window are **Control+E** and **Control+Shift+E**, respectively.

The Select item has the following submenus:

- Select All (Keyboard shortcut, **Control+A**): Selects all the objects on the active EER diagram.
- Similar Figures (Objects of the same type): Finds objects similar to the currently selected object.
- Connected Figures: Finds all the objects connected to the currently selected object.

These menu items are active only when an **EER Diagram** tab is selected. The Similar Figures and the Connected Figures menu items are disabled if no object is currently selected on an EER diagram.

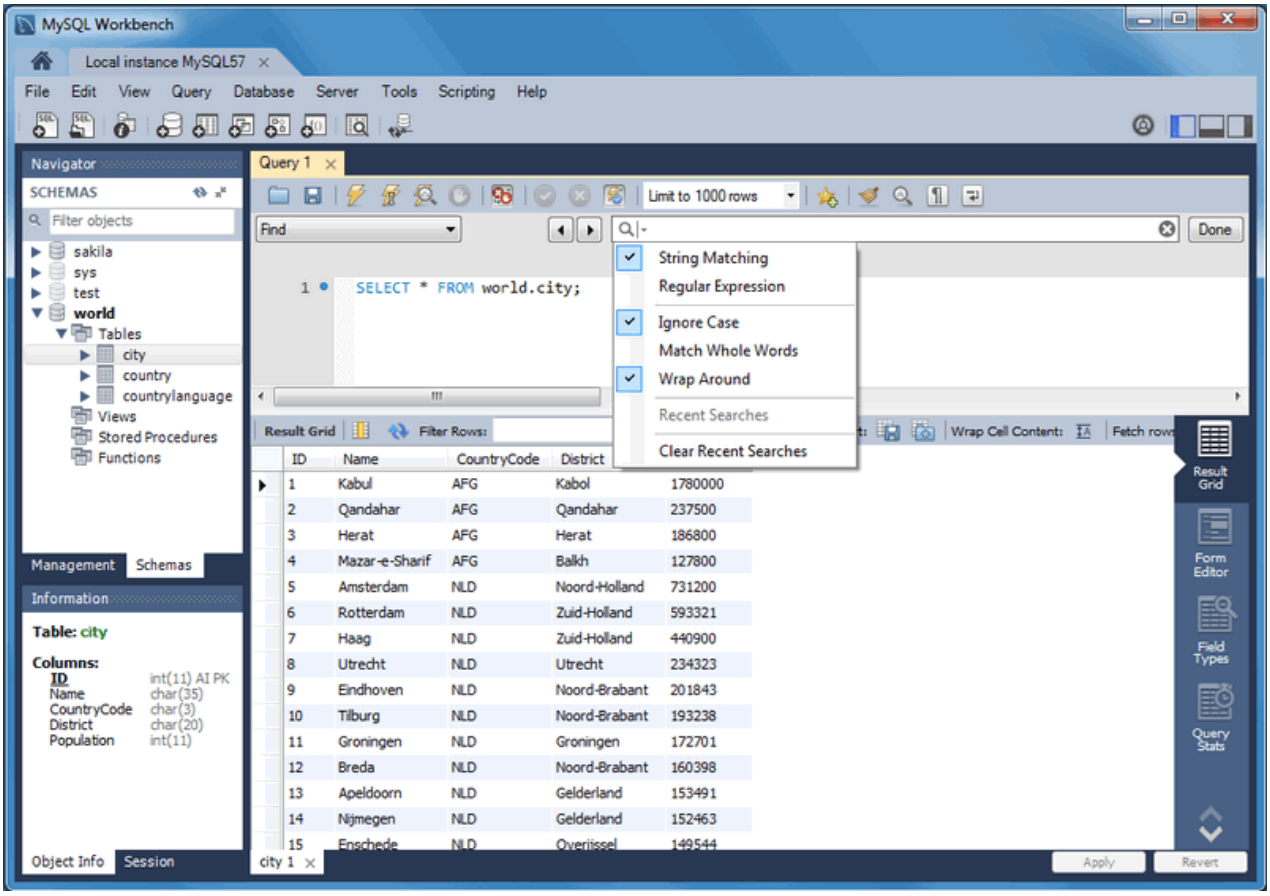
When multiple objects have been selected using one of these menu items, you can navigate between selected items by choosing the Go to Next Selected or Go to previous Selected menu item.

Selecting objects changes some of the Edit menu items. If only one object is selected, that object's name appears after the Cut, Copy and Delete menu items. If more than one object is selected, these menu items show the number of objects selected.

Find Dialog Window

Each MySQL Workbench window includes search functionality. The Find panel with Find & Replace enabled is shown below:

Figure 9.2 The Find Panel with Find & Replace



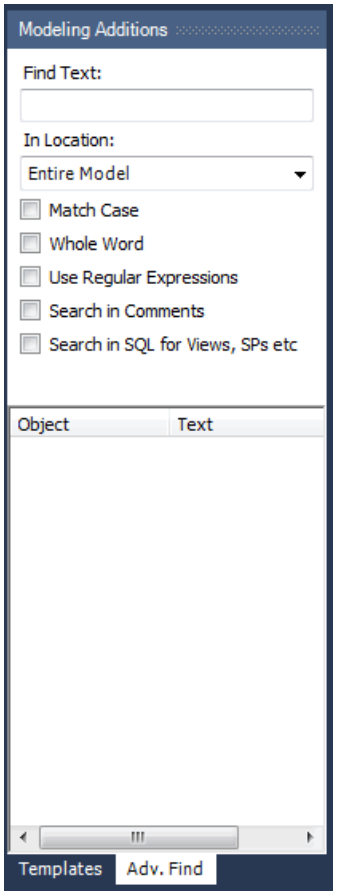
Find options

The Find dialogue options are described below:

- String Matching (default) or Regular Expression: Search by matching a string, or a PCRE regular expression.
- Ignore Case: A case-insensitive search. Works with both the String Matching and Regular Expression search methods. Enabled by default.
- Match Whole Words: If enabled, only whole strings are matched. For example, a search for "home" would not match "home_id". Disabled by default.
- Wrap Around: The search will wrap around to the beginning of the document, as otherwise it will only search from the cursor position to the end of the document. Enabled by default.
- And the arrows jump to the discovered search terms, and behave according to the Wrap Around option.

The MySQL Workbench commercial editions include an advanced Find facility for models:

Figure 9.3 The Find Window



You can search the following locations:

- Entire Model: Searches the entire model.
- Current View: Searches the current view only. This may be the `MySQL Model` page.
- All Views: Searches the `MySQL Model Page` and all EER diagrams.

- Database Objects: Searches database objects only.
- Selected Figures: Searches the currently selected objects. This feature works only for EER diagrams.

Enter the text you wish to search for in the **Find Text** list. You may also select any or all of the following check boxes:

- Match Case
- Whole Word
- Use Regular Expression
- Search in Comments
- Search in SQL for Views, SPs etc.

Any text you enter into the **Find Text** list is retained for the duration of your session. Use the Next or Previous buttons to find occurrences of your search criterion.

Clicking the Find All button opens a **Find Results** window anchored at the bottom of the application. If you wish, you may undock this window as you would any other.

Use this window to navigate to objects. For example, double-clicking the `Description` of an object located on an EER diagram navigates to the specific diagram and selects the object. Notice that the properties of the object are displayed in the `Properties` palette.

The `Find` dialog window can also be opened using the **Control+F** key combination. Use **Control+G** to find the next occurrence and **Control+Shift+G** to find a previous occurrence. Close the `Find` dialog window by clicking the `x` in the top right corner or by pressing the **Esc** key.

Workbench Preferences

This menu item enables you to set global preferences for the MySQL Workbench application.

For further information, see Section 3.2, “Workbench Preferences”.

The View Menu

This context-aware menu features general options for changing the view in MySQL Workbench. These options change depending on the current tab, and here are the available View menu items:

General options:

- Home: Selects the Home window
- Panels: Configure which of the three available panels are open. You may also manage this from the GUI using the panel toggle buttons on the top-right side of MySQL Workbench.
- Output: Displays the console output.
- Select Next Main Tab: Selects the next (moves to the right, and wraps around) MySQL Workbench tab.
- Select Next Main Tab: Selects the previous (moves to the left, and wraps around) MySQL Workbench tab.

Model/EER options:

- Windows: A submenu with items that activate (slide open) specific panels. Designated panels include the "Model Navigator", "Catalog", "Layers", "User Datatypes", "Object Descriptions", "Object Properties", and "Undo History".

- Zoom 100%: The default level of detail of an EER diagram
- Zoom In: Zooms in on an EER diagram.
- Zoom Out: Zooms out from an EER diagram.

  The ability to zoom in on an EER diagram is also available using the slider tool in the `Model Navigator` palette. See Section 9.1.1.9, “The Model Navigator Panel”.

- Set Marker: Bookmarks an object. From the keyboard, select the object you wish to bookmark, then use the key combination **Control+Shift** and the number of the marker (1 through 9). You may create up to nine markers.
- Go To Marker: Returns to a marker. From the keyboard, use the **Control** key and the number of the marker.
- Toggle Grid: Displays grid lines on an EER diagram.
- Toggle Page Guides: Toggles Page Guides to help design the EER diagram on a per-page basis.

The Arrange Menu

The Arrange menu items apply only to objects on an EER diagram canvas and are enabled only if an EER diagram view is active. The Arrange menu has these items:

- Align to Grid: Aligns items on the canvas to the grid lines
- Bring to Front: Brings objects to the foreground
- Send to Back: Sends objects to the background
- Center Diagram Contents: Centers objects on the canvas
- Autolayout: Automatically arranges objects on the canvas
- Reset Object Size: Expands an object on an EER diagram. For example, if a table has a long column name that is not fully displayed, this menu item expands the table to make the column visible. This menu item is not enabled unless an object is selected.
- Expand All: Use this item to expand all objects on an EER diagram. This item will display a table's columns if the object notation supports expansion. Some object notations, such as `Classic`, do not permit expansion or contraction. Indexes will not automatically be expanded unless they were previously expanded and have been collapsed using the Collapse All menu item.
- Collapse All: Undo the operation performed by Expand All.

The Model Menu

When a model is opened, this menu features actions to perform against your model, and the Model menu has these items:

- Add Diagram: Creates a new EER Diagram. The keyboard shortcut is **Control+T**.
- Create Diagram From Catalog Objects: Creates an EER diagram from all the objects in the catalog.
- User Defined Types: Presents a dialog box that enables you to add and delete user defined data types.
- DBDoc – Model Reporting...: For information about this menu item, see The DBDoc Model Reporting Dialog Window (Commercial Version). Commercial version only.

- Validation: Checks the validity of the model using ANSI standards. For information about this menu item, see The Validation Submenus (Commercial Version). Commercial version only.
- Validation (MySQL): Checks the validity of the model using MySQL standards. For information about this menu item, see The Validation Submenus (Commercial Version). Commercial version only.
- Object Notation: For information about this menu item, see The Object Notation Submenu.
- Relationship Notation: For information about this menu item, see The Relationship Notation Submenu.
- Diagram Properties and Size: Opens a diagram size dialog box that enables you to adjust the width or height of the canvas. The unit of measure is pages; the default value is two.

  When you have tables with numerous columns, use this menu item to increase the size of the EER.
- Model Options: Sets options at the model level. These options should not be confused with the options that are set globally for the Workbench application, and which are referred to as Workbench Preferences. The available model options are a subset of the Workbench Preferences options.

  For more information about Workbench Preferences, see Section 3.2.4, “Modeling Preferences”.

The DBDoc Model Reporting Dialog Window (Commercial Version)

This dialog window is found by navigating to the Model menu and choosing the DBDoc - Model Reporting... item.

Note

The DBDoc - Model Reporting... feature is only available in the MySQL Workbench commercial editions.

Use this dialog window to set the options for creating documentation of your database models. For more information, see Section 9.2.2, “DBDoc Model Reporting”.

The Validation Submenus (Commercial Version)

The Model menu has two validation submenus, Validation and Validation (MySQL). Use these submenus for general validation and MySQL-specific validation of the objects and relationships defined in your model.

Note

These items are only available in the MySQL Workbench commercial editions.

The Validation submenu has these items:

- Validate All: Performs all available validation checks
- Empty Content Validation: Checks for objects with no content, such as a table with no columns
- Table Efficiency Validation: Checks the efficiency of tables, such as a table with no primary key defined
- Duplicate Identifiers Validation: Checks for duplicate identifiers, such as two tables with the same name
- Consistency Validation: Checks for consistent naming conventions
- Logic Validation: Checks, for example, that a foreign key does not reference a nonprimary key column in the source table

The Validation (MySQL) submenu has these items:

- Validate All: Performs all available validation checks
- Integrity Validation: Checks for invalid references, such as a table name longer than the maximum permitted
- Syntax validation: Checks for correct SQL syntax
- Duplicate Identifiers Validation (Additions): Checks for objects with the same name

For detailed information about validation, see Section 9.2.3, “Schema Validation Plugins”.

The Object Notation Submenu

The items under the Model, Object Notation submenu apply exclusively to an EER diagram. They are not enabled unless an EER diagram tab is selected.

The Object Notation submenu has these items:

- Workbench (Default): Displays table columns, indexes, and triggers
- Workbench (Simplified): Shows only a table's columns
- Classic: Similar to the `Workbench (Simplified)` style showing only the table's columns
- IDEF1X: The ICAM DEFinition language information modeling style

The object notation style that you choose persists for the duration of your MySQL Workbench session and is saved along with your model. When MySQL Workbench is restarted, the object notation reverts to the default.

Note

If you plan to export or print an EER diagram be sure to decide on a notation style first. Changing notation styles after objects have been placed on a diagram can significantly change the appearance of the diagram.

The Relationship Notation Submenu

The items under the Relationship Notation submenu apply exclusively to an EER diagram. They are not enabled unless an EER diagram tab is selected.

The Relationship Notation submenu has these items:

- Crow's Foot (IE): The default modeling style. For an example, see Figure 9.24, “Adding Tables to the Canvas”.
- Classic: Uses a diamond shape to indicate cardinality.
- Connect to Columns
- UML: Universal Modeling Language style.
- IDEF1X: The ICAM DEFinition language information modeling method

To view the different styles, set up a relationship between two or more tables and choose the different menu items.

The relationship notation style that you choose persists for the duration of your MySQL Workbench session and is saved along with your model. When MySQL Workbench is restarted, the relationship notation reverts to the default, the `Crow's Foot` style.

Note

If you plan to export or print an EER diagram, be sure to decide on a notation style first. Changing notation styles after objects have been placed on a diagram can significantly change the appearance of the diagram.

The Database Menu

This menu features actions against the connected MySQL server. The Database menu has these items:

- Query Database: Launches the SQL Editor, which enables you to create SQL code and execute it on a live server. For more information, see Section 8.1, “Visual SQL Editor”.
- Manage Connections: Launches the **Manage Server Connections** dialog, which enables you to create and manage multiple connections. For more information, see Section 5.3, “Manage Server Connections”
- Reverse Engineer: Creates a model from an existing database. For more information, see Section 9.4.2.2, “Reverse Engineering a Live Database”.
- Forward Engineer: Creates a database from a model. For more information, see Section 9.4.1.2, “Forward Engineering to a Live Server”.
- Schema Transfer Wizard...: Executes the database migration wizard for MySQL databases. It is useful for moving from an older MySQL server to the latest MySQL version, and is meant for local development purposes. You should not use this tool on production MySQL instances as they often require more complex data migration techniques.

  For additional information about this wizard, see MySQL Schema Transfer Wizard.
- Migration Wizard...: Executes the database migration wizard for most any database, and is meant to migrate tables and data from supported database systems to your MySQL server. For additional information, see Chapter 10, *Database Migration Wizard*.
- Edit Type Mappings for Generic Migration: From here you can define custom type mappings, such as migrating the source data type `int8` to the target MySQL data type `BIGINT`.
- Synchronize Model: Synchronizes your database model with an existing database. For more information, see Section 9.5.1, “Database Synchronization”.
- Synchronize with Any Source: Allows you to compare a target database or script with the open model, external script, or a second database, and apply these changes back to the target. For more information, see Section 9.5.1, “Database Synchronization”.
- Compare Schemas: Compares your schema model with a live database or a script file. Section 9.5.2, “Compare and Report Differences in Catalogs”.

The Tools Menu

The Tools menu lists tools and utilities that related to MySQL Workbench usage.

- Browse Audit Log File: Launches a file browser to open a specific audit log file. MySQL Workbench prompts for sudo access if the MySQL Workbench user is unable to read the audit log file. For additional information about the Audit Inspector, see Section 6.6, “MySQL Audit Inspector Interface”. Commercial only.
- Configuration: Backup (or restore) your MySQL Connections, as defined in MySQL Workbench. Connection data is stored in a `connections.xml` file, for additional information about this file, see Section 3.3, “MySQL Workbench Settings and Log Files”.

- Utilities: These utilities generate PHP code to either "Connect to the MySQL server" or "Iterate SELECT results", if applicable. For additional information about PHP code generation, see Section 8.1.12.2, “Generating PHP Code”.
- Start Shell for MySQL Utilities: Opens the `mysqluc` MySQL Utility. For additional information about MySQL Utilities, see Appendix F, *MySQL Utilities*.

The Scripting Menu

This menu features GRT scripting and plugin options. The Scripting menu has these items:

- Scripting Shell: Launches the MySQL Workbench Scripting Shell. For additional information, see Section C.5, “The Workbench Scripting Shell”.
- New Script: Opens a **New Script File** dialogue, with options to create a Python Script, Python Plugin, or Python Module.
- Open Script: Opens a **Open GRT Script** dialogue, which defaults to the Workbench scripts directory. Files are opened into the **Workbench Scripting Shell** window.
- Run Script File: Executes the script that is currently open.
- Run Workbench Script File: Executes the specified script file.
- Install Plugin/Module File: Loads and installs a plugin or module file
- Plugin Manager: Displays information about the plugins that are installed, and allows disabling and uninstalling the plugins.

The Help Menu

Use the Help menu when you require support, or when you want to help improve MySQL Workbench. This menu has the following items:

- Help Index: Opens a window showing a local copy of the MySQL Workbench documentation. Read, search, or print the documentation from this window.
- MySQL.com Website: Opens your default browser on the MySQL Web site home page.
- Workbench Product Page: Opens your default browser on the MySQL Workbench product page.
- System Info: Displays information about your system, which is useful when reporting a bug. For more information, see System Info.
- Report a Bug: Opens your default browser to bugs.mysql.com, and automatically fills in several fields such as the Operating System and MySQL Workbench version by passing in additional data via the GET request. The default "Description" requests you to also attach the Workbench log file. For additional information about reporting useful bug reports, see Appendix D, *How To Report Bugs or Problems*.
- View Reported Bugs: Opens your default browser to see a list of current bugs.
- Locate Log Files: Opens up the directory that contains the MySQL Workbench log files.
- Show Log File: Opens up the main MySQL Workbench log file in your default text editor. This file is typically named `wb.log`.
- Check For Updates: Checks if you are using the current MySQL Workbench version. If you are, then a popup informs you of this. If not, then a prompt asks you to open the MySQL Workbench download page.

- About Workbench: Displays the MySQL Workbench `About` window. This also displays the MySQL Workbench version.

System Info

Use the Help, System Info menu item to display information about your system. This item is especially useful for determining your rendering mode. Sample output follows.

```
MySQL Workbench Community (GPL) for Windows version 6.1.4  revision 11773 build 1454
Configuration Directory: C:\Users\philip\AppData\Roaming\MySQL\Workbench
Data Directory: C:\Users\philip\Desktop\MySQL\MySQL Workbench 6.1.4 CE
Cairo Version: 1.8.8
OS: Microsoft Windows 7  Service Pack 1 (build 7601), 64-bit
CPU: 4x Intel(R) Core(TM) i5-2400 CPU @ 3.10GHz, 8.0 GiB RAM
Active video adapter NVIDIA GeForce GT 610
Installed video RAM: 1024 MB
Current video mode: 1920 x 1080 x 4294967296 colors
Used bit depth: 32
Driver version: 9.18.13.2049
Installed display drivers: nvd3dumx.dll,nvwgf2umx.dll,nvwgf2umx.dll,nvd3dum,nvwgf2um,nvwgf2um
Current user language: English (United States)
```

9.1.1.2 The Toolbar

The MySQL Workbench toolbar is located immediately below the menu bar. Click the tools in the toolbar to perform the following actions:

- The new document icon: Creates a new document
- The folder icon: Opens a MySQL Workbench file (`mwb` extension)
- The save icon: Saves the current MySQL Workbench project
- The right and left arrows: The left arrow performs an “Undo” operation. The right arrow performs a “Redo” operation.

Other tools appear on the toolbar depending upon the context.

Tool-Specific Toolbar Items

When an EER diagram canvas is selected, the following icons appear to the right of the arrow icons:

- The toggle grid icon: Turns the grid on and off
- The grid icon: Aligns objects on the canvas with the grid
- The new EER diagram icon: Creates a new EER diagram tab.

The toolbar also changes depending upon which tool from the vertical toolbar is active. For discussion of these tools, see Section 9.1.2.1, “The Vertical Toolbar”.

If the `Table` tool is active, schemata lists, engine types, and collations appear on the toolbar. The table properties can be modified using the Properties Editor.

When an object is selected, the object's properties, such as color, can be changed in the Properties Editor.

9.1.1.3 EER Diagrams

Use the `Add new Diagram` icon in the `MySQL Model` area to create EER diagrams. When you add an EER diagram, a new tab appears below the toolbar. Use this tab to navigate to the newly created EER diagram. For further discussion of EER Diagrams, see Section 9.1.2, “EER Diagram Editor”.

9.1.1.4 The Physical Schemata Panel

The `Physical Schemata` panel of the `MySQL Model` page shows the active schemata and the objects that they contain.

Expand and contract the `Physical Schemata` section by double-clicking the arrow on the left of the `Physical Schemata` title bar. When the `Physical Schemata` section is expanded, it displays all currently loaded schemata.

Each schema shows as a tab. To select a specific schema, click its tab. When MySQL Workbench is first opened, a default schema, `mydb`, is selected. You can start working with this schema or you can load a new MySQL Workbench Model file (models use the `.mwb` extension.)

There are a variety of ways to add schema to the `Physical Schemata` panel. You can open an MWB file, reverse engineer a MySQL create script, or, if you are using a commercial version of MySQL Workbench, you can reverse engineer a database by connecting to a MySQL server.

You can also add a new schema by clicking the `+` button on the top right of the `Physical Schemata` panel. To remove a schema, click its tab and use the `-` button found to the immediate left of the `+` button. To the left of these buttons are three buttons that control how database object icons are displayed:

- The left button displays database objects as large icons.
- The middle button displays small icons in multiple rows.
- The right button displays small icons in a single list.

The Schema Objects Panel

The `Physical Schemata` panel has the following sections:

- Tables
- Views
- Routines
- Routine Groups

Each section contains the specified database objects and an icon used for creating additional objects.

Any database objects added to an EER diagram canvas also show up in the `Physical Schemata` section. For information about adding objects to an EER diagram canvas, see Section 9.1.2, “EER Diagram Editor”.

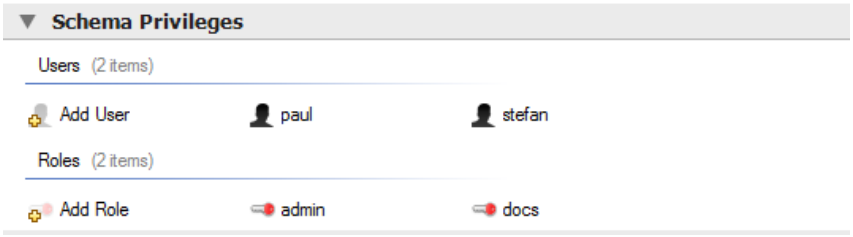
9.1.1.5 The Schema Privileges Panel

The `Schema Privileges` panel has the following sections, used to create users for your schemata and to define roles —:

- Users
- Roles

The following image displays the `Schema Privileges` section of the `MySQL Model` tab.

Figure 9.4 Roles and Privileges



Adding Roles

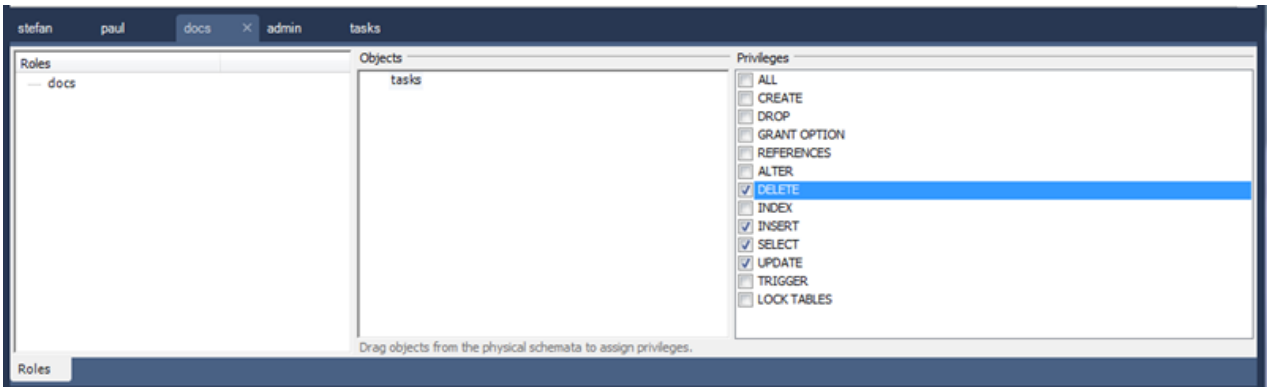
To add a role, double-click the `Add Role` icon. This creates a role with the default name `role1`. Right-clicking a role opens a pop-up menu with the following items:

- Cut '*`role_name`*': Cuts the role
- Copy '*`role_name`*': Copies the role
- Edit Role...: Opens the role editor
- Edit in New Window...: Opens the role editor in a new editor window
- Delete '*`role_name`*': Removes the role
- Copy SQL to Clipboard: Currently not implemented

To rename a role, click the role name. Then you will be able to edit the text.

All defined roles are listed under **Roles** on the left side of the role editor. Double-clicking a role object opens the role editor docked at the bottom of the page.

Figure 9.5 Role Editor



Select the role to which you wish to add objects. You may drag and drop objects from the `Physical Schemata` to the `Objects` section of the role editor. To assign privileges to a role, select it from the `Roles` section, then select an object in the `Objects` section. In the `Privileges` section, check the rights you wish to assign to this role. For example, a `web_user` role might have only `SELECT` privileges and only for database objects exposed through a web interface. Creating roles can make the process of assigning rights to new users much easier.

Adding Users

To add a user, double-click the `Add User` icon. This creates a user with the default name `user1`. Double-clicking this user opens the user editor docked at the bottom of the application.

In the User Editor, set the user's name and password using the **Name** and **Password** fields. Assign one role or a number of roles to the user by selecting the desired roles from the field on the right and then clicking the < button. Roles may be revoked by moving them in the opposite direction.

Right-clicking a user opens a pop-up menu. The items in the menu function as described in Adding Roles.

9.1.1.6 The SQL Scripts Panel

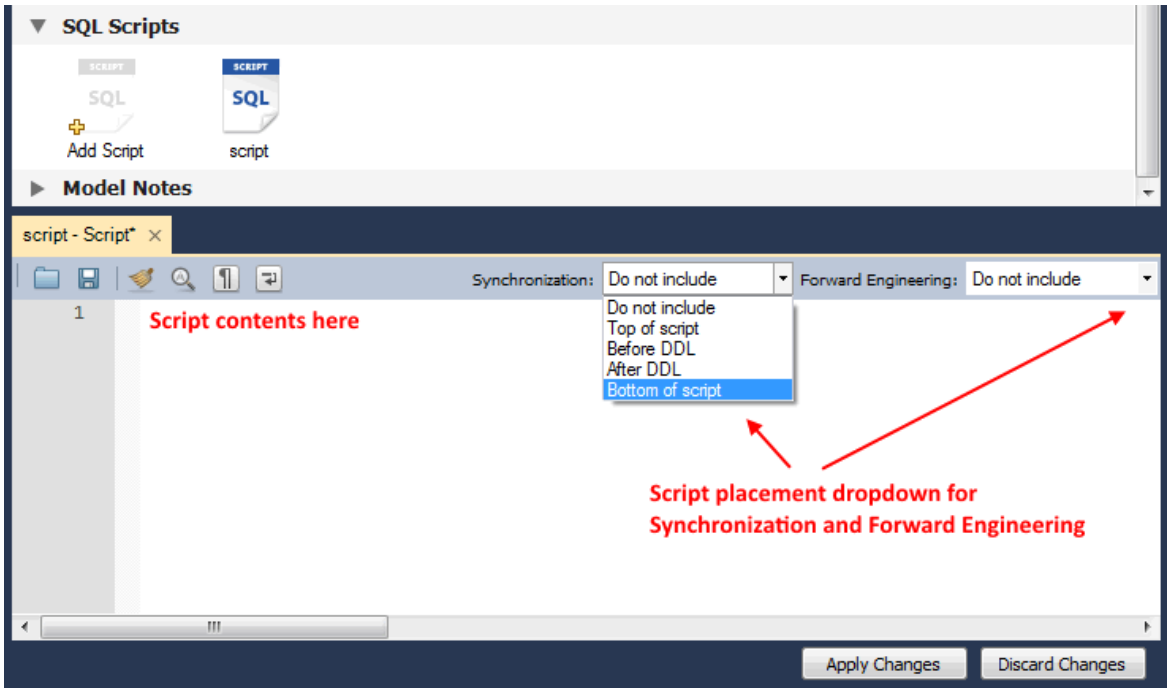
Use the SQL Scripts panel to attach SQL scripts to the model for documentation and organizational purposes, and optionally these attachments can be included in the output script when performing forward engineering or model/schema synchronization.

If you created your project from an SQL script and plan to create an ALTER script, you may want to add the original script here, since it will be needed to create an ALTER script. For more information, see Altering a Schema.

Note

The ability to use the attachments when performing forward engineering and synchronization was added in MySQL Workbench 6.2.0.

Figure 9.6 SQL Scripts Editor



9.1.1.7 The Model Notes Panel

Use the Model Notes panel to write project notes. Any scripts or notes added will be saved with your project.

9.1.1.8 The History Palette

Use the History palette to review the actions that you have taken. Left-clicking an entry opens a pop-up menu with the item, Copy History Entries to Clipboard. Choose this item to select a single entry. You

can select multiple contiguous entries by pressing the **Shift** key and clicking the entries you wish to copy. Select noncontiguous entries by using the **Control** key.

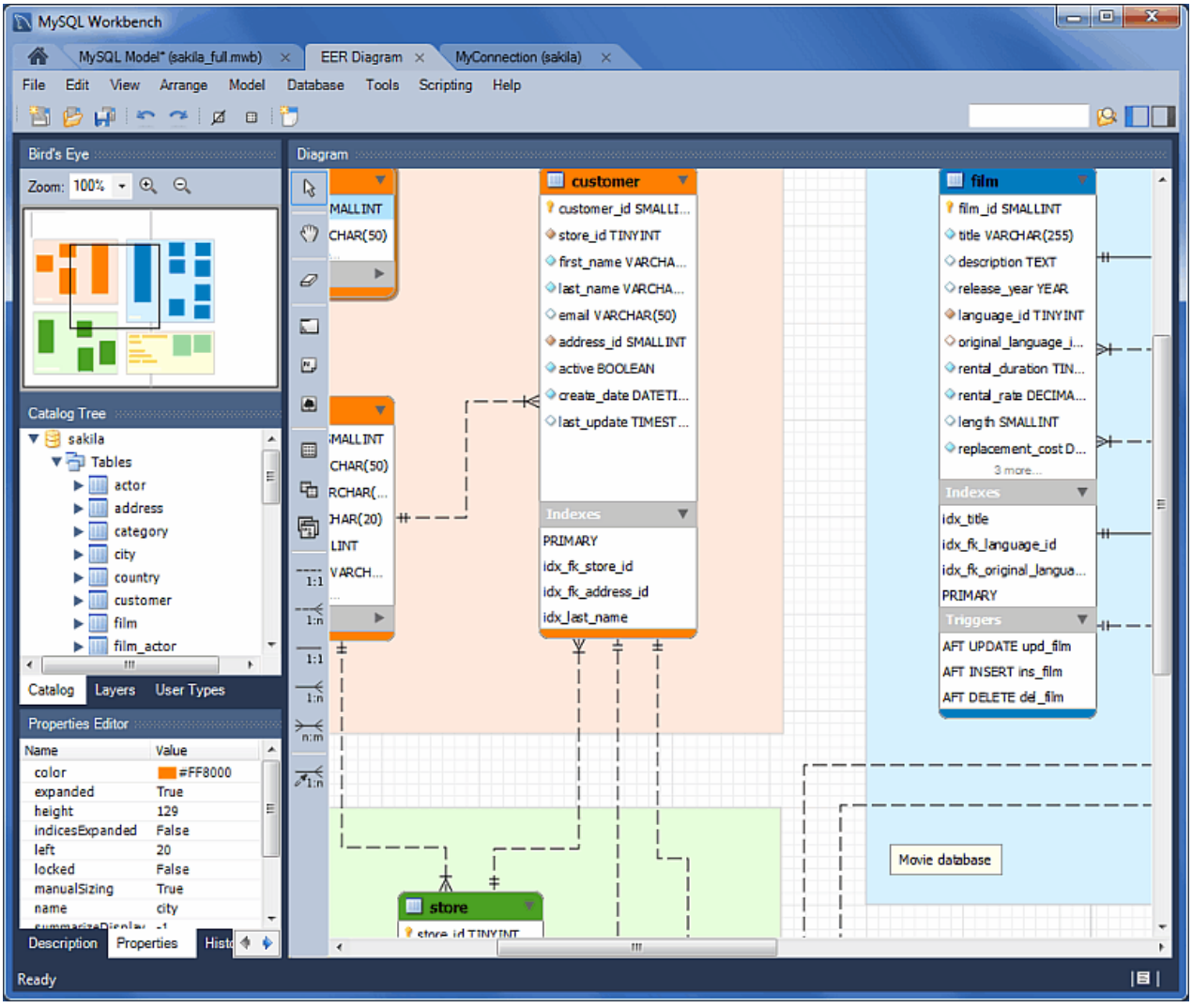
Only actions that alter the MySQL model or change an EER diagram are captured by the `History` palette.

9.1.1.9 The Model Navigator Panel

Docked at the top left of the application is the **Model Navigator**, or **Bird's Eye** panel. This panel provides an overview of the objects placed on an EER diagram canvas and for this reason it is most useful when an EER diagram is active. Any objects that you have placed on the canvas should be visible in the navigator.

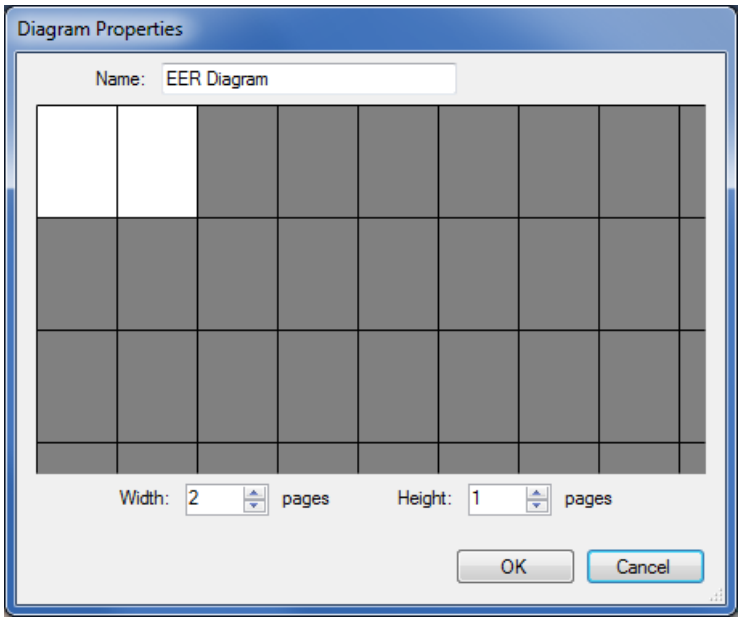
The Model Navigator shows the total area of an EER diagram. A black rectangular outline indicates the view port onto the visible area of the canvas. To change the view port of an EER diagram, left-click this black outline and drag it to the desired location. You can zoom in on selected areas of an EER diagram by using the slider tool at the bottom of this window. The dimensions of the view port change as you zoom in and out. If the slider tool has the focus, you can also zoom using the arrow keys.

Figure 9.7 The Model Navigator: Example



The default size of the `Model Navigator` is two pages. Use the Model, Diagram Properties and Size page to change the size and diagram name.

Figure 9.8 The Model Navigator Palette



9.1.1.10 The Catalog Tree Palette

The `Catalog Tree` palette shows all the schemata that are present in the `Physical Schemata` section of the `MySQL Model` page. Expand the view of the objects contained in a specific schema by clicking the `>` button to the left of the schema name. This displays the following folder icons:

- Tables
- Views
- Routine Groups

Expand each of these in turn by clicking the `>` button to the left of the folder icon.

The Catalog Tree palette is primarily used to drag and drop objects onto an EER diagram canvas.

You can toggle the sidebar on and off using the **Toggle Sidebar** button, which is located in the top right of the application.

9.1.1.11 The Layers Palette

This palette shows all of the layers and figures on an EER diagram. If a layer or figure is currently selected, an `X` appears beside the name of the object and its properties are displayed in the `Properties` palette. This is useful when determining the selected objects multiple objects were selected using the options under the Select menu item. For more information on this topic, see The Edit Menu.

Selecting an object in the `Layers` palette also adjusts the view port to the area of the canvas where the object is located.

Finding Invisible Objects Using the Layers Palette

In some circumstances, you may want to make an object on an EER diagram invisible. Select the object and, in the `Properties` palette, set the `visible` property to `False`.

The Layer palette provides an easy way to locate an object, such as a relationship, that has been set to hidden. Open the Layers palette and select the object by double-clicking it. You can then edit the object and change its visibility setting to Fully Visible.

9.1.1.12 The Properties Palette

The Properties palette is used to display and edit the properties of objects on an EER diagram. It is especially useful for editing display objects such as layers and notes.

Selecting an object in the EER diagram displays its properties in the Properties palette.

All objects except connections have the following properties except as noted:

- color: The color accent of the object, displayed as a hexadecimal value. Change the color of the object by changing this value. Only characters that are legal for hexadecimal values may be entered. You can also change the color by clicking the ... button to open a color changing dialog box.
- description: Applicable to layers only. A means of documenting the purpose of a layer.
- expanded: This attribute applies to objects such as tables that can be expanded to show columns, indexes, and triggers.
- height: The height of the object. Depending upon the object, this property may be read only or read/write.
- left: The number of pixels from the object to the left side of the canvas.
- locked: Whether the object is locked. The value for this attribute is either true or false.
- manualSizing: Whether the object was manually sized. The value for this attribute is either true or false.
- name: The name of the object.
- top: The number of pixels from the object to the top of the canvas.
- visible: Whether the object shows up on the canvas. Use '1' for true and '0' for false. It is currently used only for relationships.
- width: The width of the object. Depending upon the object, this property may be read only or read/write.

Tables have the following additional properties:

- indexesExpanded: Whether indexes are displayed when a table is placed on the canvas. Use '1' for true and '0' for false.
- triggersExpanded: Whether triggers are displayed when a table is placed on the canvas. Use '1' for true and '0' for false.

For a discussion of connection properties, see Section 9.1.4.3, "Connection Properties".

9.1.2 EER Diagram Editor

EER diagrams are created by double-clicking the Add Diagram icon. You may create any number of EER diagrams just as you may create any number of physical schemata (databases). Each EER diagram shows as a tab below the toolbar; a specific EER diagram is selected by clicking its tab.

Clicking an EER diagram tab navigates to the canvas used for graphically manipulating database objects. The Vertical Toolbar is on the left side of this page.

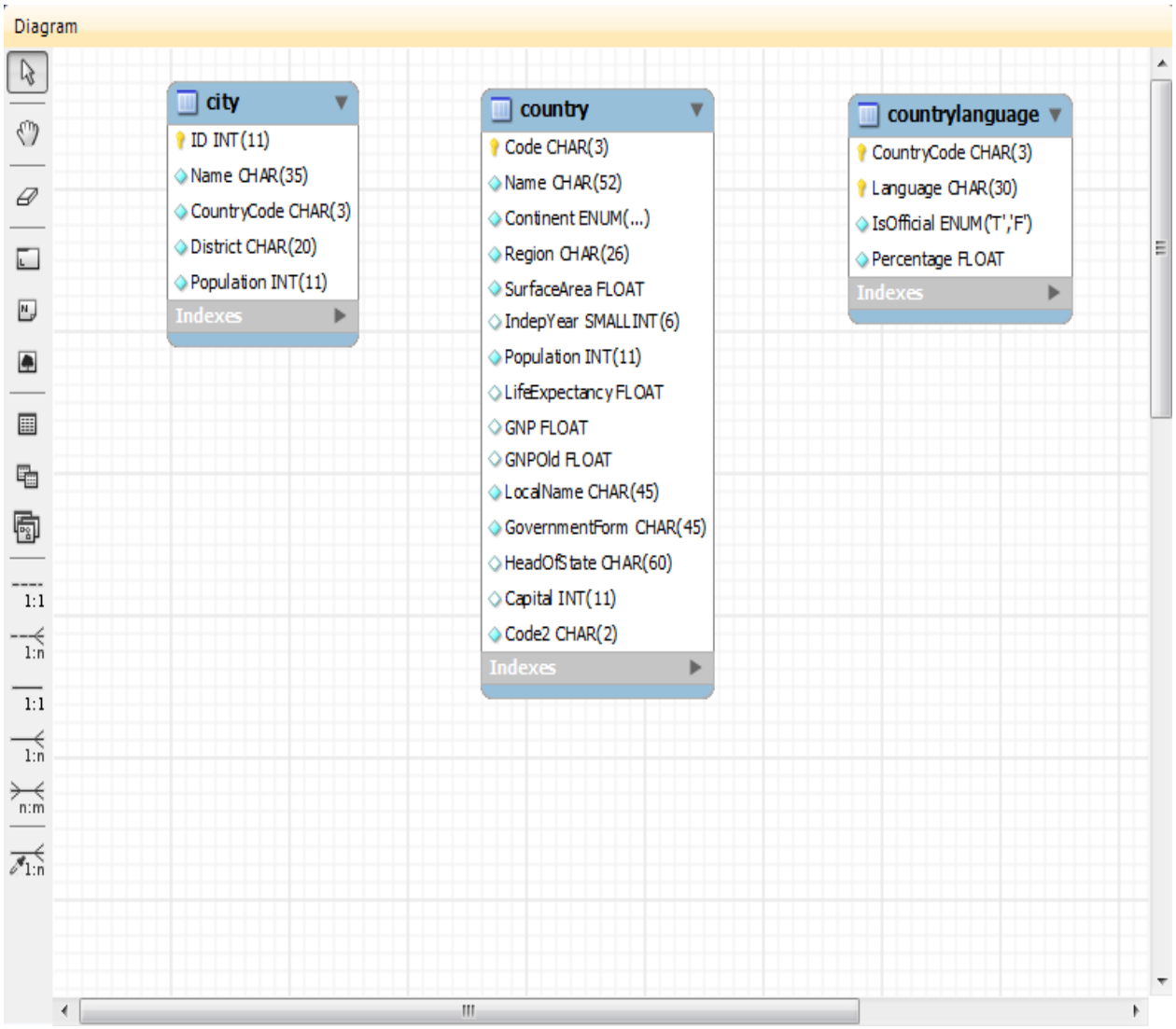
Note

This tool is for creating and editing EER diagrams for a model. To edit an existing database, either reverse engineer the database to create a model, or syncronize your model to a database. For additional information, see Section 9.4.2.2, “Reverse Engineering a Live Database” and Section 9.5, “Schema Synchronization and Comparison”.

9.1.2.1 The Vertical Toolbar

The vertical toolbar shows on the left sidebar when an EER diagram tab is selected. The tools on this toolbar assist in creating EER diagrams.

Figure 9.9 The Vertical Toolbar



Clicking a tool changes the mouse pointer to a pointer that resembles the tool icon, indicating which tool is active. These tools can also be activated from the keyboard by pressing the key associated with the tool. Hover the mouse pointer over a toolbar icon to display a description of the tool and its shortcut key.

A more detailed description of each of these tools follows.

The Standard Mouse Pointer

The standard mouse pointer, located at the top of the vertical toolbar, is the default mouse pointer for your operating system. Use this tool to revert to the standard mouse pointer after using other tools.

To revert to the default pointer from the keyboard, use the **Esc** key.

The Hand Tool

The hand tool is used to move the entire EER diagram. Left-click on this tool and then left-click anywhere on the EER diagram canvas. Moving the mouse while holding down the mouse button changes the view port of the canvas.

To determine your position on the canvas, look at the `Model Navigator` panel on the upper right. If the `Model Navigator` panel is not open, use View, Windows, Model Navigator to open it.

To activate the hand tool from the keyboard, use the **H** key.

You can also change the view port of an EER diagram using the `Model Navigator` panel. See Section 9.1.1.9, “The Model Navigator Panel”.

The Eraser Tool

Use the eraser tool to delete objects from the EER Diagram canvas. Change the mouse pointer to the eraser tool, then click the object you wish to delete. Depending upon your settings, the delete dialog box should open, asking you to confirm the type of deletion.

Note

The delete action of the `eraser` tool is controlled by the general option setting for deletion. Before using the eraser tool, be sure that you understand the available options described in Section 3.2.4, “Modeling Preferences”.

To activate the eraser tool from the keyboard, use the **D** key.

You can also delete an object by selecting it and pressing **Control+Delete** or by right-clicking it and choosing Delete from the pop up menu.

The Layer Tool

The layer tool is the rectangular icon with a capital `L` in the lower left corner. Use the layer tool to organize the objects on an EER Diagram canvas. It is useful for grouping similar objects. For example, you may use it to group all your views.

Click the layer tool and use it to draw a rectangle on the canvas. Change to the standard mouse pointer tool and pick up any objects you would like to place on the newly created layer.

To change the size of a layer, first select it by clicking it. When a layer is selected, small rectangles appear at each corner and in the middle of each side. Adjust the size by dragging any of these rectangles.

You can also make changes to a layer by selecting the layer and changing properties in the `Properties` panel. Using the `Properties` panel is the only way to change the name of a layer.

To activate the layer tool from the keyboard, use the **L** key. For more information about layers, see Section 9.1.7, “Creating Layers”.

The Text Tool

The text tool is the square icon with a capital `N` in the top left corner. Use this tool to place text objects on the EER diagram canvas. Click the tool, then click the desired location on the canvas. After a text object has been dropped on the canvas, the mouse pointer reverts to its default.

To add text to a text object, right-click the text object and choose Edit Note... or Edit in New Window... from the pop-up menu.

You can manipulate the properties of a text object by selecting it and then changing its properties in the `Properties` panel.

To activate the text tool from the keyboard, use the **N** key. For more information about text objects, see Section 9.1.9, “Creating Text Objects”.

The Image Tool

Use the image tool to place an image on the canvas. When this tool is selected and you click the canvas, a dialog box opens enabling you to select the desired graphic file.

To activate the image tool from the keyboard, use the **I** key. For more information about images, see Section 9.1.10, “Creating Images”.

The Table Tool

Use this tool to create a table on the EER Diagram canvas.

Clicking the canvas creates a table. To edit the table with MySQL Table Editor, right-click it and choose Edit Table... or Edit in New Window... from the pop-up menu. You can also double-click the table to load it into the table editor.

To activate the table tool from the keyboard, use the **T** key.

For more information about creating and editing tables, see Section 8.1.11, “The MySQL Table Editor”.

The View Tool

Use this tool to create a view on an EER Diagram canvas. When the table tool is activated, a schema list appears on the toolbar below the main menu, enabling you to associate the new view with a specific schema. You can also select a color for the object by choosing from the color list to the right of the schema list.

After selecting this tool, clicking the canvas creates a new view. To edit this view, right-click it and choose Edit View... or Edit in New Window... from the pop-up menu.

To activate the view tool from the keyboard, use the **V** key.

For more information about creating and editing views, see Section 9.1.5, “Creating Views”.

The Routine Group Tool

Use this tool to create a routine group on the EER Diagram canvas. When this tool is activated, a schema list appears on the toolbar below the main menu, enabling you to associate the routine group with a specific schema. You can also select a color for the routine group by choosing from the color list to the right of the schema list.

After selecting this tool, clicking the canvas creates a new group. To edit this view, right-click it and choose Edit Routine Group... or Edit in New Window... from the pop-up menu.

To activate the routine group tool from the keyboard, use the **G** key.

For more information about creating and editing routine groups, see Section 9.1.6.2, “Routine Groups”.

The Relationship Tools

The five relationship tools are used to represent the following relationships:

- One-to-many nonidentifying relationships
- One-to-one nonidentifying relationships
- One-to-many identifying relationships
- One-to-one identifying relationships
- Many-to-many identifying relationships

These tools appear at the bottom of the vertical tool bar. Hover the mouse pointer over each tool to see a text hint that describes its function.

For more information about relationships, see Section 9.1.4, “Creating Foreign Key Relationships”.

9.1.3 Creating Tables

9.1.3.1 Adding Tables to the Physical Schemata

Double-clicking the `Add table` icon in the `Physical Schemata` section of the `MySQL Model` page adds a table with the default name of `table1`. If a table with this name already exists, the new table is named `table2`.

Adding a new table automatically opens the table editor docked at the bottom of the application. For information about using the table editor, see Section 8.1.11, “The MySQL Table Editor”.

Right-clicking a table opens a context menu with the following items:

- Cut '*`table_name`*': Cut a table to optionally paste it into another schema.
- Copy '*`table_name`*': Copy a table to optionally paste it into another schema.
- Paste '*`table_name`*': Paste a cut or copied table. The Paste option is also accessable from the main Edit menu.
- Edit Table...: Changes the docked table editor to the selected table.
- Edit in New Tab...: Opens the table in a new table editor tab.
- Copy SQL to Clipboard: Copies a `CREATE TABLE` statement for the table.
- Copy Column Names to Clipboard: Copies a comma-separated list of column names.
- Copy Insert to Clipboard: Copies `INSERT` statements based on the model's inserts. Nothing is copied to the clipboard if the table has no inserts defined.
- Copy Insert Template to Clipboard: Copies a generic `INSERT` statement that is based on the model.
- Delete '*`table_name`*': Remove a table from the database.

Warning

This immediately deletes the table without a confirmation dialog box.

If the table editor is not open, the Edit Table... item opens it. If it is already open, the selected table replaces the previous one. Edit in New Tab... opens an additional table editor tab.

Any tables added to the `Physical Schemata` section also show up in the `Catalog` palette on the right side of the application. They may be added to an EER Diagram by dragging and dropping them from this palette.

9.1.3.2 Adding Tables to an EER Diagram

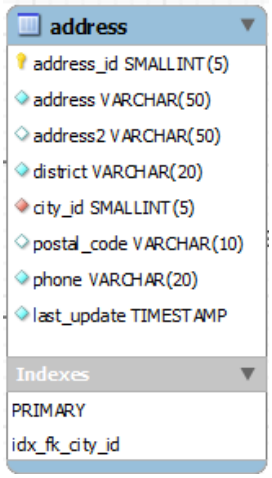
Tables can also be added to an EER Diagram using the `table` tool on the vertical toolbar. Make sure that the **EER Diagram** tab is selected, then right-click the table icon on the vertical toolbar. The table icon is the rectangular tabular icon.

Clicking the mouse on this icon changes the mouse pointer to a table pointer. You can also change the mouse pointer to a table pointer by pressing the **T** key.

Choosing the `table` tool changes the contents of the toolbar that appears immediately below the menu bar. When the `Tables` pointer is active, this toolbar contains a schemata list, an engines list, a collations list, and a color chart list. Use these lists to select the appropriate schema, engine, collation, and color accent for the new table. Make sure that you associate the new table with a database. The engine and collation of a table can be changed using the table editor. The color of your table can be changed using the `Properties` palette. The `Default Engine` and `Default Collation` values refer to the database defaults.

Create a table by clicking anywhere on the EER Diagram canvas. This creates a new table with the default name `table1`. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

Figure 9.10 A Table on an EER Diagram



As shown in the preceding diagram, the primary key is indicated by a key icon and indexed fields are indicated by a different colored diamond icon. Click the arrow to the right of the table name to toggle the display of the fields. Toggle the display of indexes and triggers in the same way.

Right-clicking a table opens a pop-up menu with the following items:

- Cut '*`table_name`*'

- Copy '*table_name*'
- Paste
- Edit '*table_name*'
- Edit '*table_name*' in New Tab...
- Copy SQL to Clipboard
- Copy Column Names to Clipboard
- Copy Inserts to Clipboard
- Copy Insert Template to Clipboard
- Delete '*table_name*'
- Remove Figure '*table_name*'

With the exception of the deletion item, these menu items function as described in Section 9.1.3.1, “Adding Tables to the Physical Schemata”. The behavior of the delete option is determined by your MySQL Workbench options settings. For more information, see Section 3.2.4, “Modeling Preferences”.

9.1.4 Creating Foreign Key Relationships

Foreign key constraints are supported for the `InnoDB` storage engine only. For other storage engines, the foreign key syntax is correctly parsed but not implemented. For more information, see Foreign Key Differences.

Using MySQL Workbench you may add a foreign key from within the table editor or by using the relationship tools on the vertical toolbar of an EER Diagram. This section deals with adding a foreign key using the foreign key tools. To add a foreign key using the table editor, see Section 8.1.11.4, “The Foreign Keys Tab”.

The graphical tools for adding foreign keys are most effective when you are building tables from the ground up. If you have imported a database using an SQL script and need not add columns to your tables, you may find it more effective to define foreign keys using the table editor.

9.1.4.1 Adding Foreign Key Relationships Using an EER Diagram

The vertical toolbar on the left side of an EER Diagram has six foreign key tools:

- `one-to-one non-identifying relationship`
- `one-to-many non-identifying relationship`
- `one-to-one identifying relationship`
- `one-to-many identifying relationship`
- `many-to-many identifying relationship`
- `Place a Relationship Using Existing Columns`

Differences include:

- An **identifying relationship**: identified by a solid line between tables

An identifying relationship is one where the child table cannot be uniquely identified without its parent. Typically this occurs where an intermediary table is created to resolve a many-to-many relationship. In such cases, the primary key is usually a composite key made up of the primary keys from the two original tables.

- A **non-identifying relationship**: identified by a broken (dashed) line between tables

Create or drag and drop the tables that you wish to connect. Ensure that there is a primary key in the table that will be on the “one” side of the relationship. Click on the appropriate tool for the type of relationship you wish to create. If you are creating a one-to-many relationship, first click the table that is on the “many” side of the relationship, then on the table containing the referenced key. This creates a column in the table on the many side of the relationship. The default name of this column is *`table_name_key_name`* where the table name and the key name both refer to the table containing the referenced key.

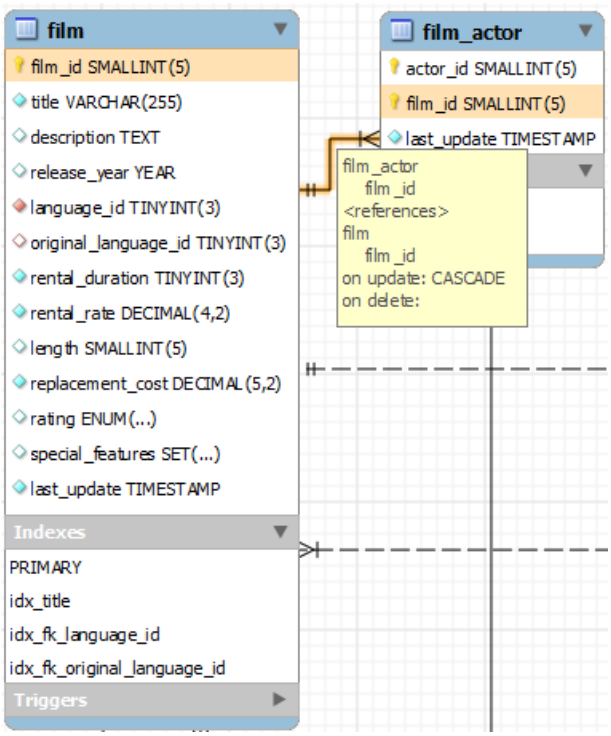
When the many-to-many tool is active, double-clicking a table creates an associative table with a many-to-many relationship. For this tool to function there must be a primary key defined in the initial table.

Use the Model menu, Menu Options menu item to set a project-specific default name for the foreign key column (see The Relationship Notation Submenu). To change the global default, see Section 3.2.4, “Modeling Preferences”.

To edit the properties of a foreign key, double-click anywhere on the connection line that joins the two tables. This opens the relationship editor.

Mousing over a relationship connector highlights the connector and the related keys as shown in the following figure. The `film` and the `film_actor` tables are related on the `film_id` field and these fields are highlighted in both tables. Since the `film_id` field is part of the primary key in the `film_actor` table, a solid line is used for the connector between the two tables. After mousing over a relationship for a second, a yellow box is displayed that provides additional information.

Figure 9.11 The Relationship Connector



If the placement of a connection's caption is not suitable, you can change its position by dragging it to a different location. If you have set a secondary caption, its position can also be changed. For more information about secondary captions, see Section 9.1.4.3, “Connection Properties”. Where the notation style permits, `Classic` for example, the cardinality indicators can also be repositioned.

The relationship notation style in Figure 9.11, “The Relationship Connector” is the default, crow's foot. You can change this if you are using a commercial version of MySQL Workbench. For more information, see The Relationship Notation Submenu.

You can select multiple connections by holding down the **Control** key as you click a connection. This can be useful for highlighting specific relationships on an EER diagram.

9.1.4.2 The Relationship Editor

Double-clicking a relationship on the EER diagram canvas opens the relationship editor. This has two tabs: **Relationship**, and **Foreign Key**.

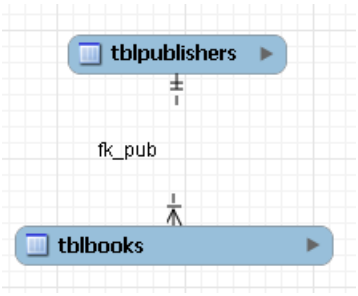
The Relationship Tab

In the **Relationship** tab, you can set the caption of a relationship using the **Caption** field. This name displays on the canvas and is also the name used for the constraint itself. The default value for this name is `fk_source_table_destination_table`. Use the Model menu, Menu Options menu item to set a project-specific default name for foreign keys. To change the global default, see Section 3.2.4, “Modeling Preferences”.

You can also add a secondary caption and a caption to a relationship.

The **Visibility Settings** section is used to determine how the relationship is displayed on the EER Diagram canvas. `Fully Visible` is the default but you can also choose to hide relationship lines or to use split lines. The split line style is pictured in the following figure.

Figure 9.12 The Split Connector



Note

A broken line connector indicates a nonidentifying relationship. The split line style can be used with either an identifying relationship or a nonidentifying relationship. It is used for display purposes only and does not indicate anything about the nature of a relationship.

To set the notation of a relationship use the Model menu, Relationship Notation menu item. For more information, see The Relationship Notation Submenu.

The Foreign Key Tab

The **Foreign Key** tab contains several sections: **Referencing Table**, **Cardinality** and **Referenced Table**.

The **Mandatory** check boxes are used to select whether the referencing table and the referenced table are mandatory. By default, both of these constraints are `true` (indicated by the check boxes being checked).

The **Cardinality** section has a set of radio buttons that enable you to choose whether the relationship is one-to-one or one-to-many. There is also a check box that enables you to specify whether the relationship is an identifying relationship.

9.1.4.3 Connection Properties

Right-click a connection to select it. When a connection is selected, it is highlighted and its properties are displayed in the properties palette. Connection properties are different from the properties of other objects. The following list describes them:

- `caption`: The name of the connection. By default, the name is the name of the foreign key and the property is centered above the connection line.
- `captionXOffs`: The X offset of the caption.
- `captionYOffs`: The Y offset of the caption.
- `comment`: The comment associated with the relationship.
- `drawSplit`: Whether to show the relationship as a continuous line.
- `endCaptionXOffs`: The X termination point of the caption offset.
- `endCaptionYOffs`: The Y termination point of the caption offset.
- `extraCaption`: A secondary caption. By default, this extra caption is centered beneath the connection line.
- `extraCaptionXOffs`: The X offset of the secondary caption.
- `extraCaptionYOffs`: The Y offset of the secondary caption.
- `mandatory`: Whether the entities are mandatory. For more information, see Section 9.1.4.2, “The Relationship Editor”.
- `many`: False if the relationship is a one-to-one relationship.
- `middleSegmentOffset`: The offset of the middle section of the connector.
- `modelOnly`: Set when the connection will not be propagated to the DDL. It is just a logical connection drawn on a diagram. This is used, for example, when drawing `MyISAM` tables with a visual relationship, but with no foreign keys.
- `name`: The name used to identify the connection on the EER Diagram canvas. Note that this is **not** the name of the foreign key.
- `referredMandatory`: Whether the referred entity is mandatory.
- `startCaptionXOffs`: The start of the X offset of the caption.
- `startCaptionYOffs`: The start of the Y offset of the caption.

In most cases, you can change the properties of a relationship using the relationship editor rather than the `Properties` palette.

If you make a relationship invisible by hiding it using the relationship editor's **Visibility Settings**, and then close the relationship editor, you will no longer be able to select the relationship to bring up its relationship

editor. To make the relationship visible again, you must expand the table object relating to the relationship in the **Layers** palette and select the relationship object. To edit the selected object, right-click it, then select Edit Object. You can then set the **Visibility Settings** to **Fully Visible**. The relationship will then be visible in the **EER Diagram** window.

9.1.5 Creating Views

You can add views to a database either from the `Physical Schemata` section of the `MySQL Model` page or from the EER Diagram.

9.1.5.1 Adding Views to the Physical Schemata

To add a view, double-clicking the `Add View` icon in the `Physical Schemata` section of the `MySQL Model` page. The default name of the view is `view1`. If a view with this name already exists, the new view is named `view2`.

Adding a new view automatically opens the view editor docked at the bottom of the application. For information about using the view editor, see Section 9.1.5.3, “The View Editor”.

Right-clicking a view opens a pop-up menu with the following items:

- Cut '*`view_name`*'

  The '*`view_name`*' is only cut from the EER canvas, and not removed from the schema.

- Copy '*`view_name`*'
- Paste
- Edit View...
- Edit in New Window...
- Copy SQL to Clipboard
- Delete '*`view_name`*': deletes from both the EER canvas and schema.
- Remove '*`view_name`*': deletes from the EER canvas, but not the schema.

If the table editor is not open, the Edit View... item opens it. If it is already open, the selected table replaces the previous one. Edit in New Window... opens a new view editor tab.

The cut and copy items are useful for copying views between different schemata. Copy SQL to Clipboard copies the `CREATE VIEW` statement to the clipboard.

Warning

Use the Delete '*`view_name`*' item to remove a view from the database. There will be **no** confirmation dialog box.

Any views added to the `Physical Schemata` section also show up in the `Catalog` palette on the left side of the application. They may be added to an EER Diagram, when in the EER Diagram tab, by dragging and dropping them from this palette.

9.1.5.2 Adding Views to an EER Diagram

Views can also be added to an EER Diagram using the `View` tool on the vertical toolbar. Make sure that the **EER Diagram** tab is selected, then left-click the view icon on the vertical toolbar. The view icon is the two overlapping rectangles found below the table icon.

Clicking this icon changes the mouse pointer to a view pointer. To change the mouse pointer to a view pointer from the keyboard, use the **V** key.

Choosing the `View` tool changes the contents of the toolbar that appears immediately below the main menu bar. When the `Views` pointer is active, this toolbar contains a schemata list and a color chart list. Use these lists to select the appropriate schema and color accent for the new view. Make sure that you associate the new view with a database. The color of your view can be changed using the `Properties` palette.

Create a view by clicking anywhere on the EER Diagram canvas. This creates a new view with the default name `view1`. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

Right-clicking a view opens a pop-up menu. With the exception of the delete item, these menu items function as described in Section 9.1.5.1, “Adding Views to the Physical Schemata”. The behavior of the delete option is determined by your MySQL Workbench options settings. For more information, see Section 3.2.4, “Modeling Preferences”.

9.1.5.3 The View Editor

To invoke the view editor, double-click a view object on the EER Diagram canvas or double-click a view in the `Physical Schemata` section on the `MySQL Model` page. This opens the view editor docked at the bottom of the application. Double-clicking the title bar undocks the editor. Do the same to redock it. Any number of views may be open at the same time. Each additional view appears as a tab at the top of the view editor.

There are three tabs at the bottom of the view editor: **View**, **Comments**, and **Privileges**. Navigate between different tabs using the mouse or from the keyboard by pressing **Control+Alt+Tab**.

The View Tab

Use the **View** tab to perform the following tasks:

- Rename the view using the **Name** text box.
- Enter the SQL to create a view using the **SQL** field.
- Comment a view using the **Comments** text area.

The Comments Tab

This tab enables you to enter comments for a particular view.

The Privileges Tab

The **Privileges** tab of the view editor functions in exactly the same way as the **Privileges** tab of the routine editor. For more information, see The Privileges Tab.

9.1.5.4 Modifying a View Using the Properties Palette

When you select a view on the EER Diagram canvas, its properties are displayed in the `Properties` palette. Most of the properties accessible from the `Properties` palette apply to the appearance of a view on the EER Diagram canvas.

For a list of properties accessible through the `Properties` palette, see Section 9.1.1.12, “The Properties Palette”.

9.1.6 Creating Routines and Routine Groups

You can add Routine Groups to a database either from the **Physical Schemata** section of the **MySQL Model** page or from an EER Diagram. Routines may be added only from the **Physical Schemata** section of the **MySQL Model** page.

To view an existing schema, along with its Routines and Routine Groups, choose Database, Reverse Engineer... from the main menu. After the schema has been added to the current model, you can see the schema objects on the **Physical Schemata** panel on the **MySQL Model** page. The Routines and Routine Groups are listed there.

MySQL Workbench unifies both stored procedures and stored functions into one logical object called a Routine. **Routine Groups** are used to group related routines. Define Routine with the **Routine Group Editor** to assign specific routines to a group, using a drag and drop interface.

When designing an EER Diagram, you can place the Routine Groups on the canvas by dragging them from the **Catalog Palette**. Placing individual routines on the diagram is not permitted, as it would clutter the canvas.

9.1.6.1 Routines

Adding Routines to the Physical Schemata

To add a routine, double-click the `Add Routine` icon in the `Physical Schemata` section of the `MySQL Model` page. The default name of the routine is `routine1`. If a routine with this name already exists, the new routine is named `routine2`.

Adding a new routine automatically opens the routine editor docked at the bottom of the application. For information about using the routine editor, see The Routine Editor.

Right-clicking a routine opens a pop-up menu with the following items:

- Rename
- Cut '*`routine_name`*'
- Copy '*`routine_name`*'
- Paste
- Edit Routine...
- Edit in New Window...
- Copy SQL to Clipboard
- Delete '*`routine_name`*'

The Edit Routine... item opens the routine editor.

The cut and paste items are useful for copying routines between different schemata.

Note

Deleting the code for a routine from the **Routines** tab of the Routine Group Editor results in removal of the routine object from the model.

Note

To remove a routine from a routine group, use the controls on the **Routine Group** tab of the Routine Group Editor.

The action of the delete option varies depending upon how you have configured MySQL Workbench. For more information, see Section 3.2.4, “Modeling Preferences”.

The Routine Editor

To invoke the routine editor, double-click a routine in the `Physical Schemata` section on the `MySQL Model` page. This opens the routine editor docked at the bottom of the application. Any number of routines may be open at the same time. Each additional routine appears as a tab at the top of the routine editor.

Routine and **Privileges** tabs appear at the bottom of the routine editor. Navigate between different tabs using the mouse or from the keyboard by pressing **Control+Alt+Tab**.

The Routine Tab

Use the **Routine** tab of the routine editor to perform the following tasks:

- Rename the routine using the **Name** field.
- Enter the SQL to create a routine using the **SQL** field.

The Privileges Tab

The **Privileges** tab of the routine editor allows you to assign specific roles and privileges. You may also assign privileges to a role using the role editor. For a discussion of this topic, see Adding Roles.

When this tab is first opened, all roles that have been created are displayed in the list on the right. Move the roles you wish to associate with this table to the **Roles** list on the left. Do this by selecting a role and then clicking the < button. Use the **Shift** key to select multiple contiguous roles and the **Control** key to select noncontiguous roles.

To assign privileges to a role, click the role in the **Roles** list. This displays all available privileges in the **Assigned Privileges** list. The privileges that display are:

- `ALL`
- `CREATE`
- `DROP`
- `GRANT OPTION`
- `REFERENCES`
- `ALTER`
- `DELETE`
- `INDEX`
- `INSERT`
- `SELECT`
- `UPDATE`

- `TRIGGER`

You can choose to assign all privileges to a specific role or any other privilege as listed previously. Privileges irrelevant to a specific table, such as the `FILE` privilege, are not shown.

If a role has already been granted privileges on a specific table, those privileges show as already checked in the **Assigned Privileges** list.

9.1.6.2 Routine Groups

Adding Routine Groups to the Physical Schemata

Double-clicking the `Add Routine Group` icon in the `Physical Schemata` section of the `MySQL Model` page adds a routine group with the default name of `routines1`. If a routine group with this name already exists, the new routine group is named `routines2`.

Adding a new routine group automatically opens the routine groups editor docked at the bottom of the application. For information about using the routine groups editor, see The Routine Group Editor.

Right-clicking a routine group opens a pop-up menu with the following items:

- Rename
- Cut '*`routine_group_name`*'
- Copy '*`routine_group_name`*'
- Edit Routine...
- Edit in New Window...
- Copy SQL to Clipboard
- Delete '*`routine_group_name`*'

The Edit Routine Group... item opens the routine group editor, which is described in The Routine Group Editor.

The cut and paste items are useful for copying routine groups between different schemata.

Deleting a routine group from the `MySQL Model` page removes the group but does not remove any routines contained in that group.

Any routine groups added to the `Physical Schemata` also show up in the `Catalog` palette on the right side of the application. They may be added to an EER diagram by dragging and dropping them from this palette.

Adding Routine Groups to an EER Diagram

To add routine groups to an EER Diagram, use the `Routine Groups` tool on the vertical toolbar. Make sure that the **EER Diagram** tab is selected, then right-click the routine groups icon on the vertical toolbar. The routine groups icon is immediately above the lowest toolbar separator.

Clicking the mouse on this icon changes the mouse pointer to a routine group pointer. You can also change the mouse pointer to a routine pointer by pressing the **G** key.

Choosing the `Routine Group` tool changes the contents of the toolbar that appears immediately below the menu bar. When the `Routine Groups` pointer is active, this toolbar contains a schemata list and a color chart list. Use these lists to select the appropriate schema and color accent for the new routine group.

Make sure that you associate the new routine group with a database. The color of your routine group can be changed later using the `Properties` palette.

Create a routine group by clicking anywhere on the EER Diagram canvas. This creates a new routine group with the default name `routines1`. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

Right-clicking a routine group opens a pop-up menu. With the exception of the delete option and rename options, these menu options function as described in Adding Routine Groups to the Physical Schemata. There is no rename option, and the behavior of the delete option is determined by your MySQL Workbench options settings. For more information, see Section 3.2.4, “Modeling Preferences”.

The Routine Group Editor

To invoke the routine group editor, double-click a routine group object on the EER Diagram canvas or double-click a routine group in the `Physical Schemata` section on the `MySQL Model` page. This opens the routine group editor docked at the bottom of the application. Double-clicking the title bar undocks the editor. Do the same to redock it. Any number of routine groups may be open at the same time. Each additional routine group appears as a tab at the top of the routine editor,

Routine group and **Privileges** tabs appear at the bottom of the routine editor. Navigate between different tabs using the mouse or from the keyboard by pressing **Control+Alt+Tab**.

The Routine Groups Tab

Use the **Routine Groups** tab of the routine groups editor to perform the following tasks:

- Rename the routine group using the **Name** field.
- Add routines to the group by dragging and dropping them.
- Add comments to the routine group.

The Privileges Tab

The **Privileges** tab of the routine group editor functions in exactly the same way as the **Privileges** tab of the table editor. For more information, see The Privileges Tab.

Modifying a Routine Group Using the Properties Palette

When you select a routine group on the EER Diagram canvas, its properties are displayed in the `Properties` palette. All of the properties accessible from the `Properties` palette apply to the appearance of a routine group on the EER Diagram canvas.

For a list of properties accessible through the `Properties` palette, see Section 9.1.1.12, “The Properties Palette”.

9.1.7 Creating Layers

You can add layers to a database only from an EER Diagram. Layers are used to help organize objects on the canvas. Typically, related objects are added to the same layer; for example, you may choose to add all your views to one layer.

9.1.7.1 Adding Layers to an EER Diagram

To add layers to an EER Diagram, use the `Layer` tool on the vertical toolbar. Select an **EER Diagram** tab and left-click the layer icon on the vertical toolbar. The layer icon is the rectangle with an `'L'` in the lower left corner and it is found below the eraser icon.

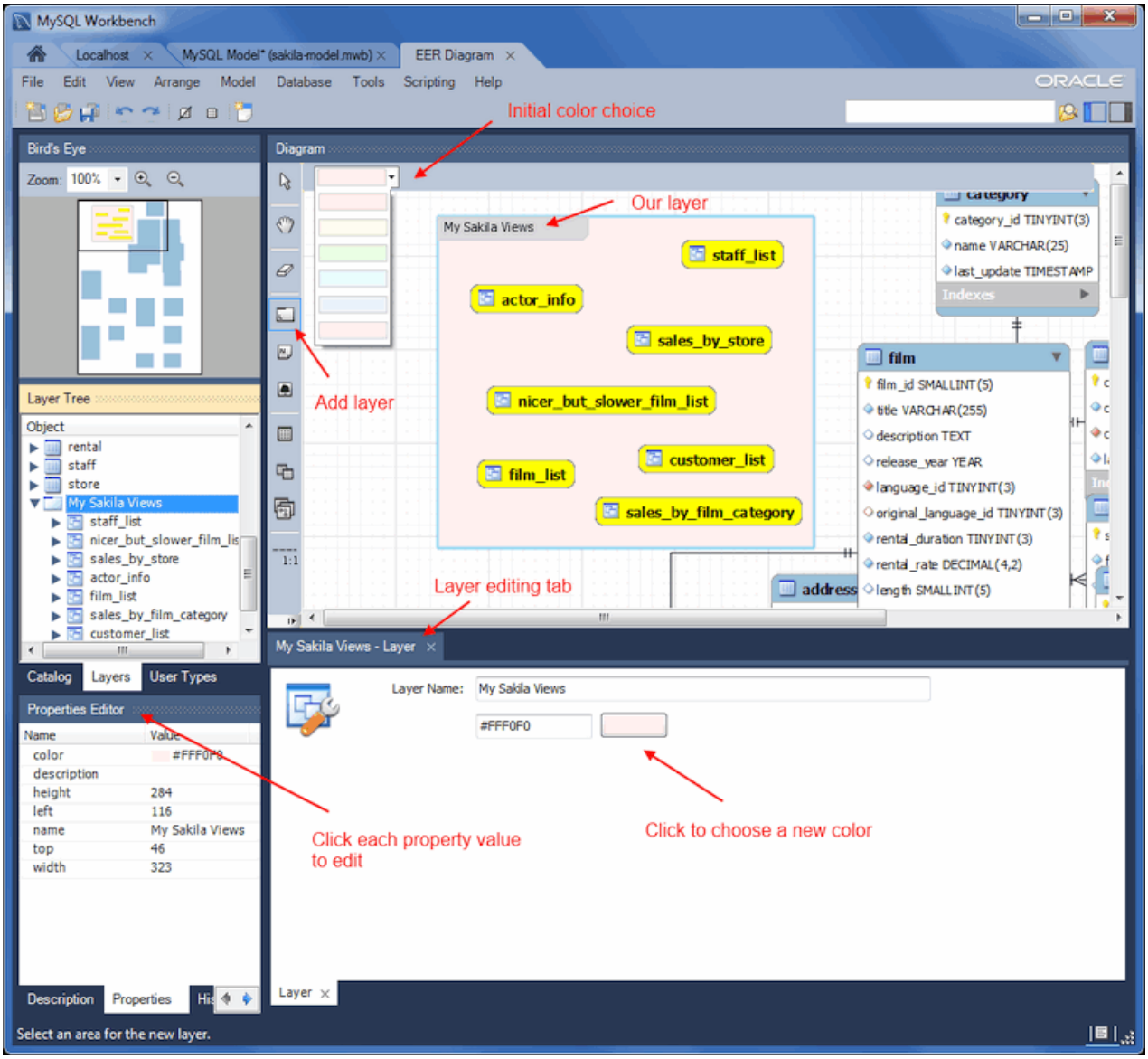
Clicking the mouse on this icon changes the mouse pointer to a layer pointer. You can also change the mouse pointer to a layer pointer by pressing the **L** key.

Choosing the `Layer` tool changes the contents of the toolbar that appears immediately below the menu bar. When the `Layers` pointer is active, this toolbar contains a color chart list. Use this list to select the color accent for the new layer. The color of your layer can be changed later using the `Properties` palette.

Create a layer by clicking anywhere on the EER Diagram canvas and, while holding the left mouse button down, draw a rectangle of a suitable size. This creates a new layer with the default name `layer1`. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

The following image shows a layer named "My Sakila Views" with several views:

Figure 9.13 The Layer Object



To open the layer editor, either double-click the layer or right-click the layer and choose the edit option. The available context-menu options are:

- Cut '*layer_name*'
- Copy '*layer_name*'
- Paste '*a_table_name*'
- Edit '*layer_name*'
- Delete '*layer_name*'

Note

A layer may also be edited via **Properties Editor** on the left panel, and it offers additional edit options.

The cut and copy items are useful for copying layers between different schemata.

Since layers are not schema objects, no confirmation dialog box opens when you delete a layer regardless of how you have configured MySQL Workbench. Deleting a layer does **not** delete schema objects from the catalog.

Adding Objects to a Layer

To add an object to a layer, drag and drop it directly from the `Catalog` palette onto a layer. If you pick up an object from an EER diagram, you must press **Control** as you drag it onto the layer, otherwise it will not be “locked” inside the layer.

Locking objects to a layer prevents their accidental removal. You cannot remove them by clicking and dragging; to remove an object, you also must press the **Control** key while dragging it.

As a visual cue that the object is being “locked”, the outline of the layer is highlighted as the object is dragged over it.

If you drag a layer over a table object, the table object will automatically be added to the layer. This also works for multiple table objects.

Layers cannot be nested. That is, a layer cannot contain another layer object.

9.1.7.2 Modifying a Layer Using the Properties Palette

Choosing "Edit" allows you to edit the layer name and layer background color, and the "Properties Editor" offers additional edit options.

When you select a layer on the EER Diagram canvas, its properties are displayed in the `Properties` palette. The properties accessible from the `Properties` palette apply to the appearance of a layer on the EER Diagram canvas.

In some circumstances, you may want to make a layer invisible. Select the layer and, in the `Properties` palette, set the `visible` property to `False`. To locate an invisible object, open the `Layers` palette and select the object by double-clicking it. After an object is selected, you can reset the `visible` property from the `Properties` palette.

For a list of properties accessible through the `Properties` palette, see Section 9.1.1.12, “The Properties Palette”. In addition to the properties listed there, a layer also has a `description` property. Use this property to document the purpose of the layer.

9.1.8 Creating Notes

You can add notes to a database only from the `Model Notes` section of the `MySQL Model` page. Notes are typically used to help document the design process.

9.1.8.1 Adding Notes

Double-clicking the `Add Note` icon in the `Model Notes` section of the `MySQL Model` page adds a note with the default name of `note1`. If a note with this name already exists, the new note is named `note2`.

Adding a new note automatically opens the note editor docked at the bottom of the application. For information about using the note editor, see Section 9.1.8.2, “The Note Editor”.

Right-clicking a note opens a pop-up menu with the following items:

- Rename
- Cut '*`note_name`*'
- Copy '*`note_name`*'
- Delete '*`note_name`*'

The Edit Note... item opens the note editor. For information about using the note editor, see Section 9.1.8.2, “The Note Editor”.

The cut and copy items are useful for copying notes between different schemata.

Notes can be added only on the `MySQL Model` page.

9.1.8.2 The Note Editor

To invoke the note editor, double-click a note object in the `Model Note` section on the `MySQL Model` page. This opens the note editor docked at the bottom of the application. Double-clicking the note tab undocks the editor. Double-click the title bar to redock it. Any number of notes may be open at the same time. Each additional note appears as a tab at the top of the note editor.

Use the editor to change the name of a note or its contents.

9.1.9 Creating Text Objects

Text objects are applicable only to an EER diagram. They can be used for documentation purposes; for example, to explain a grouping of schema objects. They are also useful for creating titles for an EER diagram should you decide to export a diagram as a PDF or PNG file.

9.1.9.1 Adding Text Objects to an EER Diagram

To add text objects to an EER Diagram, use the `Text Object` tool on the vertical toolbar. Make sure that the **EER Diagram** tab is selected, then right-click the text object icon on the vertical toolbar. The text object icon is the rectangular icon found below the label icon.

Clicking the mouse on this icon changes the mouse pointer to a text object pointer. You can also change the mouse pointer to a text object pointer by pressing the **N** key.

Choosing the `Text Object` tool changes the contents of the toolbar that appears immediately below the menu bar. When the `Text Object` pointer is active, this toolbar contains a color chart list. Use this list to

select the color accent for the new text object. The color of your text object can be changed later using the `Properties` palette.

Create a text object by clicking anywhere on the EER Diagram canvas. This creates a new text object with the default name `text1`. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

Right-clicking a text object opens a pop-up menu. These menu options are identical to the options for other objects. However, since a text object is not a database object, there is no confirmation dialog box when you delete a text object.

9.1.9.2 The Text Object Editor

To invoke the text object editor, double-click a text object on the EER Diagram canvas. This opens the editor docked at the bottom of the application. Double-clicking the text object table undocks the editor. Double-click the title bar to redock it. Any number of text objects may be open at the same time. Each additional text objects appears as a tab at the top of the text editor.

Use the editor to change the name of a text object or its contents.

Modifying a Text Object Using the Properties Palette

When you select a text object on the EER Diagram canvas, its properties are displayed in the `Properties` palette. Most of the properties accessible from the `Properties` palette apply to the appearance of a view on the EER Diagram canvas.

For a list of properties accessible through the `Properties` palette, see Section 9.1.1.12, “The Properties Palette”.

There is no property in the `Properties` palette for changing the font used by a text object. To do so, choose the **Appearance** tab of the Workbench Preferences dialog. For more information, see Preferences: Modeling: Appearance.

9.1.10 Creating Images

Images exist only on the EER Diagram canvas; you can add them only from the EER Diagram window.

9.1.10.1 Adding Images to an EER Diagram

To add images to an EER Diagram, use the `Image` tool on the vertical toolbar. Make sure that the **EER Diagram** tab is selected, then right-click the image icon on the vertical toolbar. The image icon is the icon just above the table icon.

Clicking the mouse on this icon changes the mouse pointer to an image pointer. You can also change the mouse pointer to an image pointer by pressing the **I** key.

Create an image by clicking anywhere on the EER Diagram canvas. This opens a file open dialog box. Select the desired image, then close the dialog box to create an image on the canvas. To revert to the default mouse pointer, click the arrow icon at the top of the vertical toolbar.

Right-clicking this object opens a pop-up menu with the following items:

- Cut *`'Image'`*
- Copy *`'Image'`*

- Edit Image...
- Edit in New Window...
- Delete *'Image'*

These menu items function in exactly the same way as they do for other objects on an EER diagram. However, images are not database objects so there is no confirmation dialog box when they are deleted.

9.1.10.2 The Image Editor

To invoke the image editor, double-click an image object on an EER Diagram canvas. This opens the image editor docked at the bottom of the application. Double-clicking the image editor tab undocks the editor. Double-click the title bar to redock it. Any number of images may be open at the same time. Each additional image appears as a tab at the top of the image editor.

The Image Tab

Use the **Image** tab of the image editor to perform the following tasks:

- Rename the image using the **Name** text box.
- Browse for an image using the Browse button.

Modifying a Image using the Properties Palette

When you select an image on the EER Diagram canvas, its properties are displayed in the **Properties** palette. Most of the properties accessible from the **Properties** palette apply to the appearance of an image on the EER Diagram canvas.

For a list of properties accessible through the **Properties** palette, see Section 9.1.1.12, “The Properties Palette”.

9.2 Additional Modeling Tools

Additional modeling design tools and features.

9.2.1 Printing Diagrams

The printing options used to create printouts of your EER Diagrams are found under the File menu. To create *documentation* of your models, see The DBDoc Model Reporting Dialog Window (Commercial Version).

9.2.1.1 Printing Options

The printing menu items not enabled unless an EER Diagram is active. These items are available:

- Page Setup...

  Enables you to choose the paper size, orientation, and margins.

- Print

  Sends your EER Diagram directly to the printer. This option generates a preview before printing. From the preview you can adjust the scale of the view and also choose a multi-page view. Clicking the printer

icon at the top left of this window, prints the currently selected EER Diagram. Close the print preview window if you need to adjust the placement of objects on the EER Diagram canvas.

- Print to PDF...

  Creates a PDF file of your EER Diagram.

- Print to PS...

  Creates a PostScript file of your EER Diagram.

9.2.2 DBDoc Model Reporting

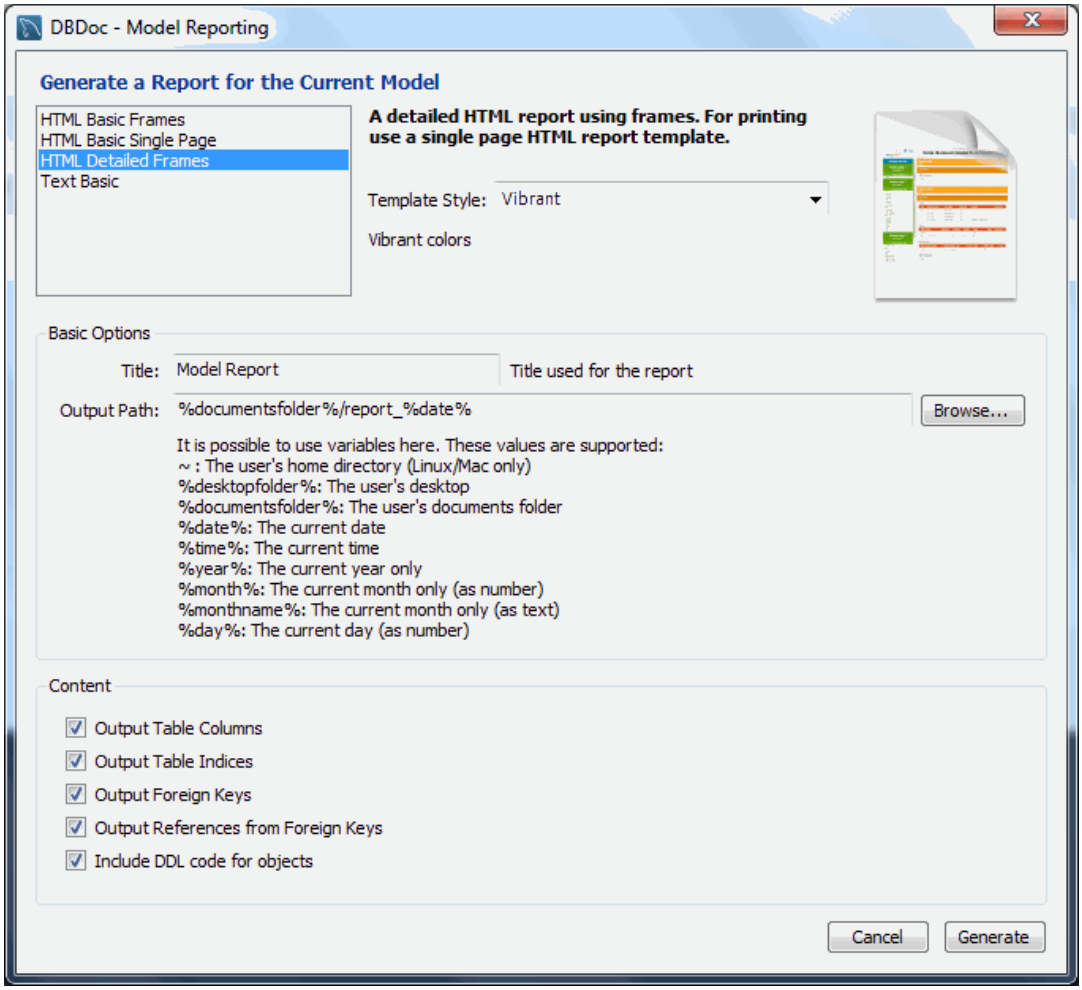
This dialog window is found by navigating to the Model menu and choosing the DBDoc - Model Reporting... item.

Note

This functionality is only available in the MySQL Workbench commercial editions.

Use this dialog window to set the options for creating documentation of your database models.

Figure 9.14 The DBDoc Model Reporting Main Wizard


DBDoc - Model Reporting
Generate a Report for the Current Model
HTML Basic Frames
HTML Basic Single Page
HTML Detailed Frames
Text Basic
A detailed HTML report using frames. For printing use a single page HTML report template.
Template Style: Vibrant
Vibrant colors
Basic Options
Title: Model Report
Title used for the report
Output Path: %documentsfolder%/report_%date%
Browse...
It is possible to use variables here. These values are supported:
~ : The user's home directory (Linux/Mac only)
%desktopfolder%: The user's desktop
%documentsfolder%: The user's documents folder
%date%: The current date
%time%: The current time
%year%: The current year only
%month%: The current month only (as number)
%monthname%: The current month only (as text)
%day%: The current day (as number)
Content
Output Table Columns
Output Table Indices
Output Foreign Keys
Output References from Foreign Keys
Include DDL code for objects
Cancel
Generate

You can choose from four available templates:

- `HTML Basic Frames`: Model documentation in HTML format that makes use of frames
- `HTML Basic Single Page`: Single Page HTML documentation, not using frames
- `HTML Detailed Frames`: Detailed HTML documentation, using frames
- `Text Basic`: Text file documentation

When you click a template, a preview image displays on the right side of the page. For the `HTML Basic Frames` template, you can select either the `Colorful` or the `Restrained Colors` option from the **Style** list. The `HTML Basic Single Page` template offers only the `Colorful` style. The `HTML Detailed Frames` template offers the `Vibrant` style, and also the more subdued `Coated` style. The `Text Basic` template offers only the `Fixed Size Font` style.

From the **Base Options** frame choose the report title and the output directory for the report files.

The following variables may be used to configure the output path:

- **~**: The user's home directory. Available on Linux and OS X versions only.
- **%desktopfolder%**: The user's desktop.
- **%documentsfolder%**: The user's Documents folders. The following table shows typical values for common platforms:

Platform	Typical Default Documents Folder
Windows	`C:\Documents and Settings\`*`user_name`*`\My Documents`
Linux	`~/Documents`
OS X	`Users/`*`user_name`*`/Documents`

- **%date%**: The date in the format YYYY-MM-DD.
- **%time%**: The time in the format HHMM.
- **%year%**: The year in the format YYYY.
- **%month%**: The month in the format MM. January is 01 and December is 12.
- **%monthname%**: The name of the month, rather than the number.
- **%day%**: The day number in the format DD. For example, the 12th would be 12.

Content options can also be set:

- `Render Table Columns`: Display all the columns.
- `Render Table Indices`: Display all the indexes.
- `Render Foreign Keys`: Display all the foreign keys.
- `List Foreign Keys that refer to that table`: Display the tables that foreign keys reference.
- `Include DDL code for objects`: Generates DDL code.

Clicking the Generate button creates the directory defined in the **Output directory** text box. If you chose to create `HTML Basic Frames`, you will find the following files in this directory:

- `basic.css`: The style sheet for the `overview.html` page.
- `index.html`: The main page.
- `overview.html`: The model overview, the navigation links shown in the sidebar.
- `restrained.css`: The CSS file used if the `Restrained Colors` style option was chosen.
- `table_details.html`: The main frame of the model report.

Choosing the `HTML Basic Single Page` option creates a style sheet and an `index.html` file.

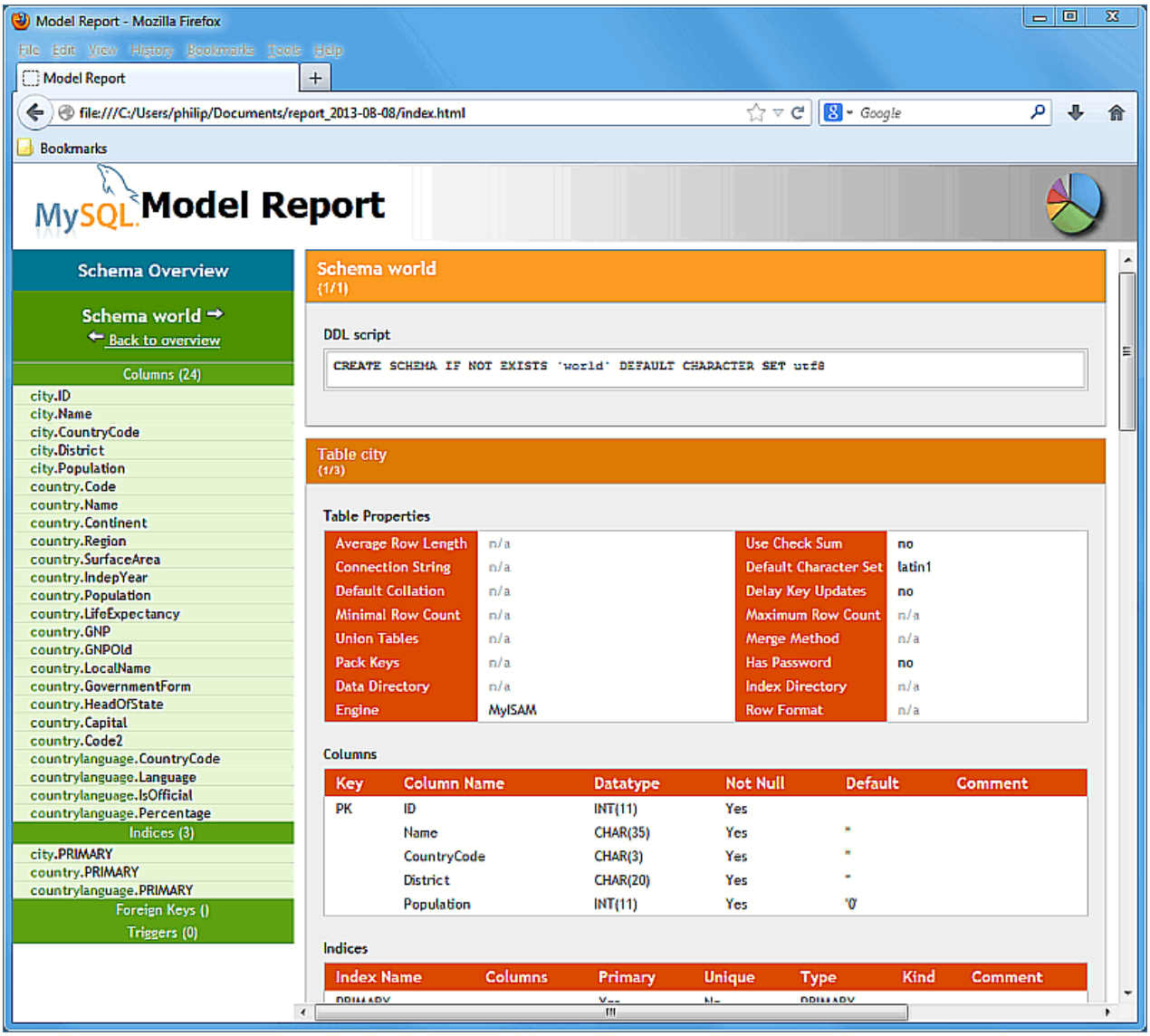
Choosing the `HTML Detailed Frames` option creates the following files:

- `basic.css`: The style sheet for the `overview.html` page. This is used if the `vibrant` style is chosen.
- `coated.css`: The CSS file used if the `Coated` style option was chosen.
- `index.html`: The main page.
- `overview.html`: Overview information for the report such as report title, project name and author.
- `overview_list.html`: A summary of schema in the model along with a list of tables contained in each schema.
- `routine_details.html`: List of all routines for the schema.
- `table_details.html`: The main report details.
- `table_details_list.html`: A Schema overview along with details of columns, indexes and foreign keys for each schema.
- `table_element_details.html`: The details for every element of the table.
- `top.html`: The top frame of the report.
- `view_details.html`: List of all columns and indexes for the schema.

Choosing the `Text Basic` option creates a directory containing one text file.

You can click `index.html` to view a report. The following screenshot shows the `HTML Detailed Frames` report being displayed:

Figure 9.15 The DBDoc Model Report



If you wish to create custom templates please refer to Section 9.7, “Customizing DBDoc Model Reporting Templates”.

9.2.3 Schema Validation Plugins

MySQL Workbench provides validation modules so that you can test your models before implementing them.

Note

This functionality is only available in the MySQL Workbench commercial editions.

The validation plugins are accessed from the Model menu. One plugin performs general validation for any Relational Database Management System (RDMS) and the other is MySQL specific. Beneath these menu items are a number of specific validation tests. Running any one of these tests opens an output window

docked at the bottom of the application. Warning messages are displayed on the left side of this window and the tests performed are displayed on the right.

The following sections outline the tasks performed by the validation modules.

9.2.3.1 General Validation

The following list names the general validation types and gives examples of specific violations:

- **Empty Content Validation**
  - A table with no columns
  - A routine or view with no SQL code defined
  - A routine group containing no routines
  - A table, view, or routine not referenced by at least one role
  - A user with no privileges
  - Objects such as tables that do not appear on at least one EER Diagram
- **Table Efficiency Validation**
  - A table with no primary key
  - A primary key that does not use an integer-based data type
  - A foreign key that refers to a column with a different data type
- **Duplicated Identifiers Validation**
  - Duplicate object names
  - Duplicate role or user names
  - Duplicate index or routine names
- **Consistency Validation**
  - Use of the same column with columns of differing data types
- **Logic Validation**
  - A foreign key that refers to a column other than the primary key in the source table
  - Any object that is object is either read only or write only by role definition
  - Placeholder objects left over from reverse engineering

9.2.3.2 MySQL-Specific Validation

The following list names the MySQL-specific validation types and gives examples of specific violations:

- **Integrity Violation**
  - An object name longer than the maximum permitted

- A foreign key defined for an engine type that does not support foreign keys (not yet implemented)
- A view or routine that references a nonexistent table (not yet implemented)
- A default value that does not match a column's data type
- An invalid partitioning scheme

- **Syntax Violation**
  - A routine, trigger, or view with incorrect SQL syntax
  - A reserved keyword used as an identifier
  - Use of an invalid character

9.3 Modeling Tutorials

This chapter contains three short tutorials intended to familiarize you with the basics of MySQL Workbench. These tutorials show how MySQL Workbench can be used both to design and to document databases.

Creating a database from scratch is the focus of Section 9.3.4, “Using the Default Schema” and exploring the graphic design capabilities of MySQL Workbench is touched upon in Section 9.3.2, “Basic Modeling”. Both these tutorials show the database design capabilities of MySQL Workbench.

Importing an SQL data definition script is probably the quickest way to familiarize yourself with MySQL Workbench—this tutorial makes use of the `sakila` database and emphasizes the use of MySQL Workbench as a documentation tool. Examples taken from the `sakila` database are used throughout the documentation, so this installation procedure is recommended.

9.3.1 Creating a Model

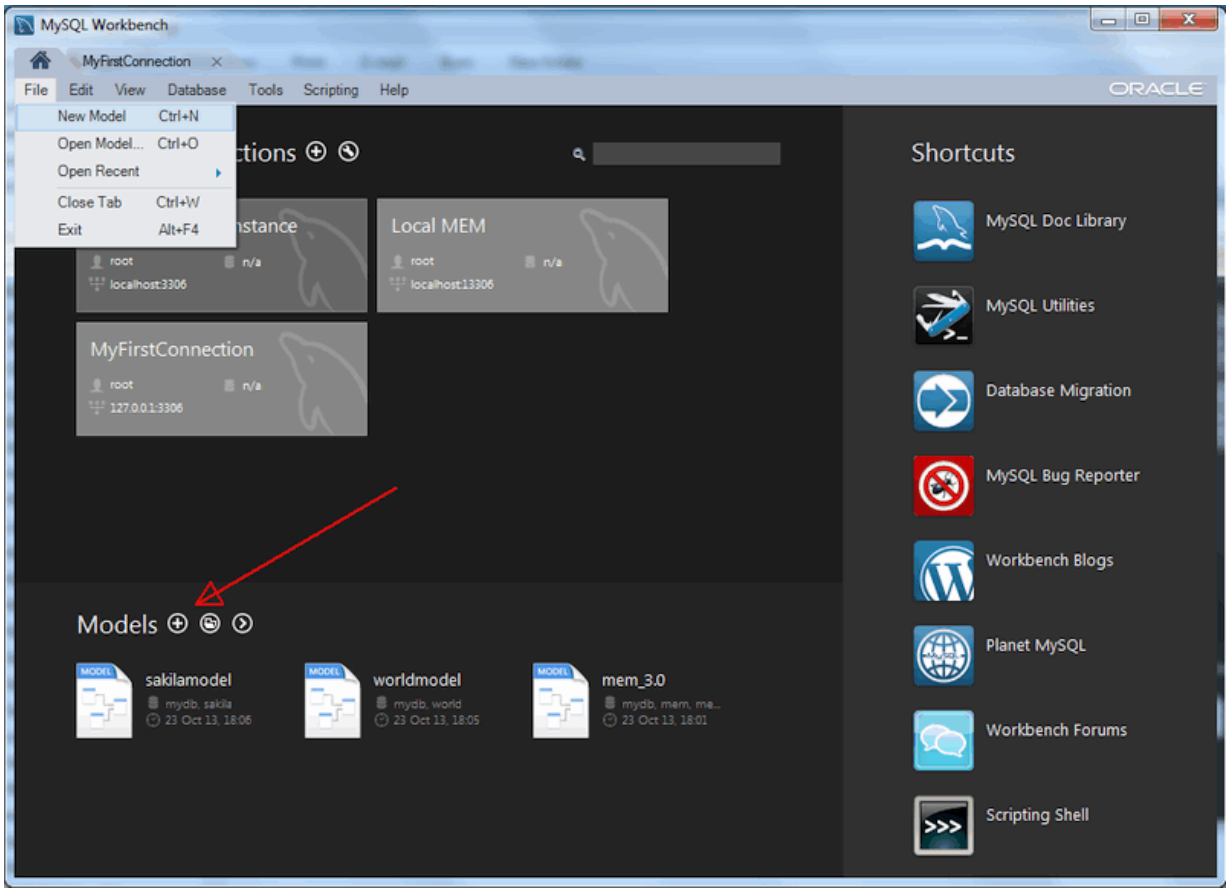
This section provides a tutorial introduction to MySQL models by showing you how to create a new database model, and how to forward engineer a model to a live MySQL server.

Note

Alternatively, you can create a model from a database by using the reverse engineering wizard. For additional information, see Section 9.4.2.2, “Reverse Engineering a Live Database”.

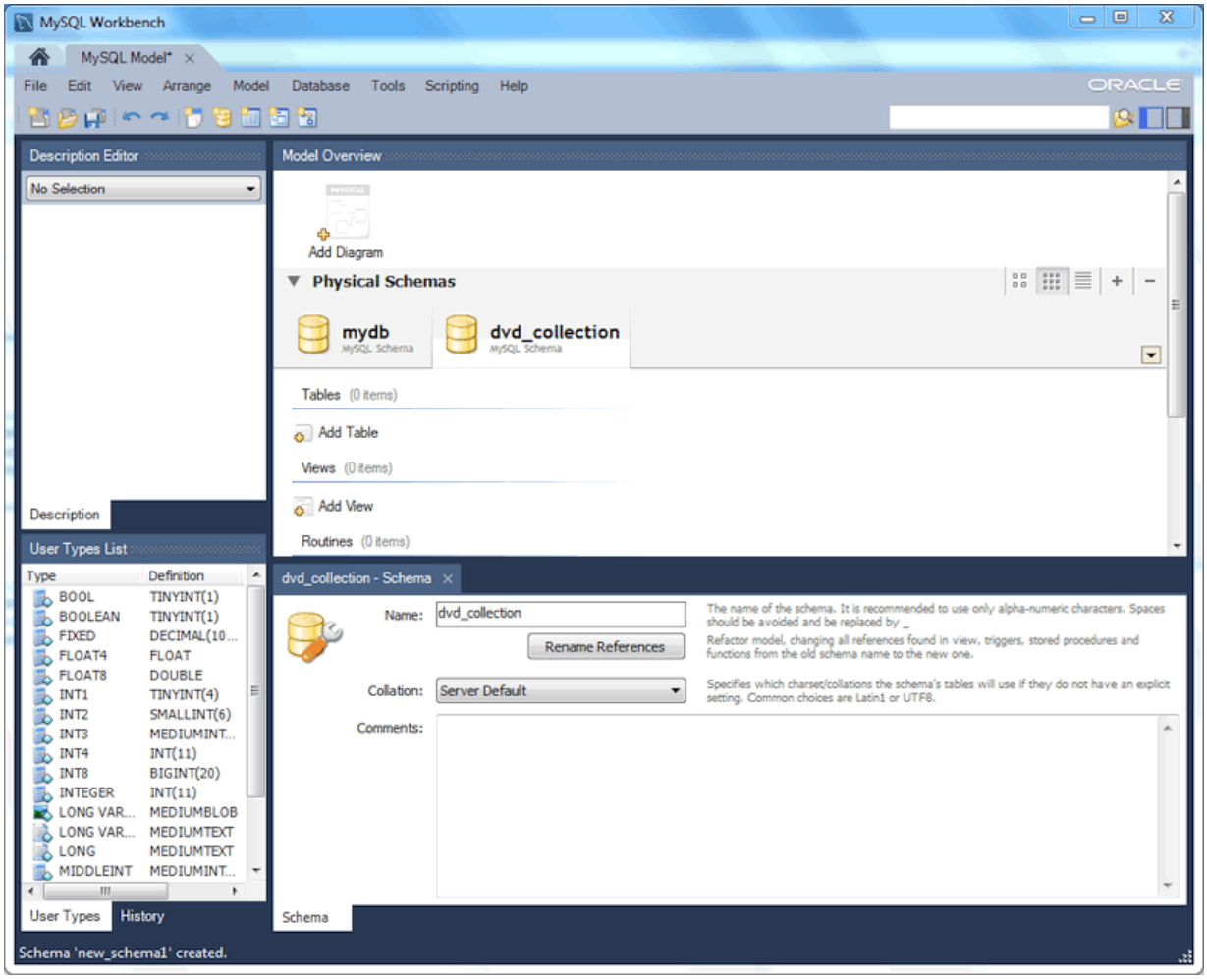
1. Start MySQL Workbench. On the Home window, click the **[+]** icon next to the **Models** section on the bottom of the page, or select File, New Model. A model can contain multiple schemata. Note that when you create a new model, it contains the `mydb` schema by default. You can change the name of this schema to serve your own purposes, or delete it.

Figure 9.16 Getting Started Tutorial - Home Window



2. Click the + button on the right side of the **Physical Schemata** toolbar to add a new schema. The default schema name is "new_schema1", now change it to “dvd_collection” by modifying its **Name** field. Confirm this change in the **Physical Schemata** panel. Now you are ready to add a table.

Figure 9.17 Getting Started Tutorial - New Schema



3. Double-click **Add Table** in the **Physical Schemata** section.

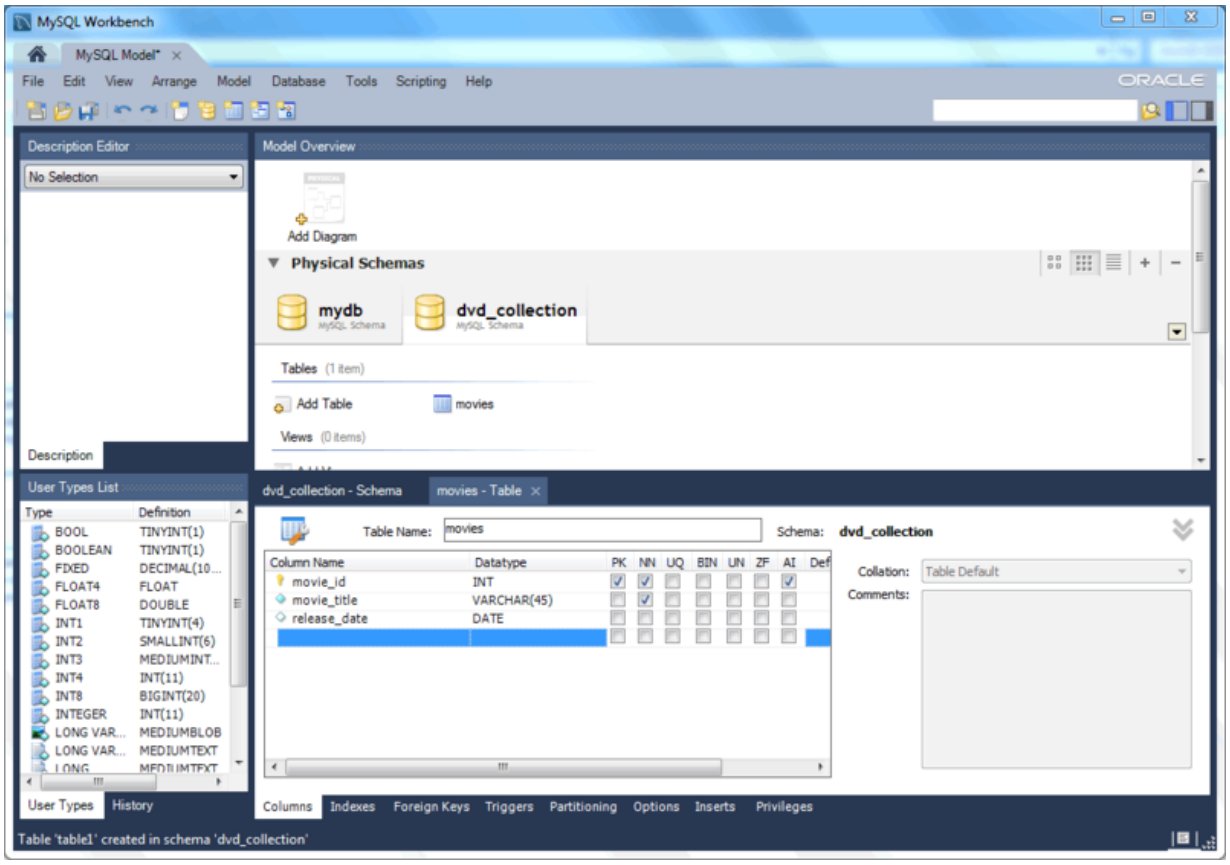
4. This automatically loads the table editor with the default table name **table1**. Edit its **Table Name** field and change the table name from “table1” to “movies”.

5. Next, add columns to your table. Double-click a **Column Name** cell, and the first field defaults to “moviesid” because (by default) MySQL Workbench appends “id” to the table name for the initial field. Change “moviesid” to “movie_id” and keep the **Datatype** as `INT`, and also select the **PK** (PRIMARY KEY), **NN** (NOT NULL), and **AI** (AUTO_INCREMENT) check boxes.

6. Add two additional columns using the same method as described above:

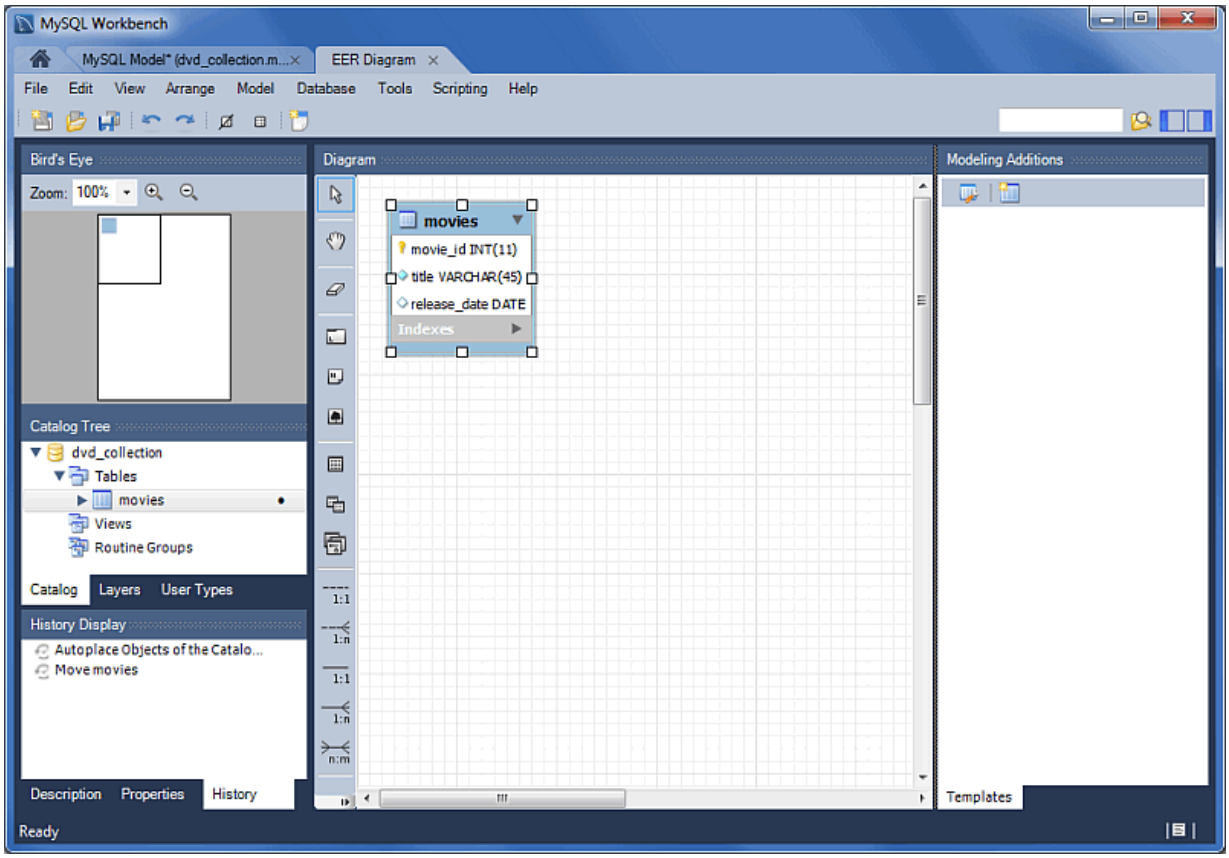
Column Name	Data Type	Column Properties
movie_title	VARCHAR(45)	NN
release_date	DATE (YYYY-MM-DD)	None

Figure 9.18 Getting Started Tutorial - Editing table columns



7. For a visual representation (EER diagram) of this schema, select Model, Create Diagram from Catalog Objects to create the EER Diagram for the model.

Figure 9.19 Getting Started Tutorial - EER Diagram



8. In the table editor, change the name of the column “movie_title” to “title”. Note that the EER Diagram is automatically updated to reflect this change.

Note

To open the table editor, either change back to the **MySQL Model** tab and right-click on the `movies` table, or right-click on `movies` in the EER diagram and select an Edit 'movies' option.

9. Save the model by choosing File, Save Model from the main menu, or click Save Model to Current File on the toolbar. Enter a model name at the file prompt. For this tutorial, enter “Home_Media” and then Save the model.

10. Before synchronizing your new model with the live MySQL server, confirm that you already created a MySQL connection. This tutorial assumes you followed the previous Section 5.2, “Creating A New MySQL Connection (Tutorial)” tutorial to create a MySQL connection named **MyFirstConnection**, although an alternative connection can also work.

11. Now forward engineer your model to the live MySQL server. Select Database, Forward Engineer... from the main menu to open the **Forward Engineer to Database** wizard.

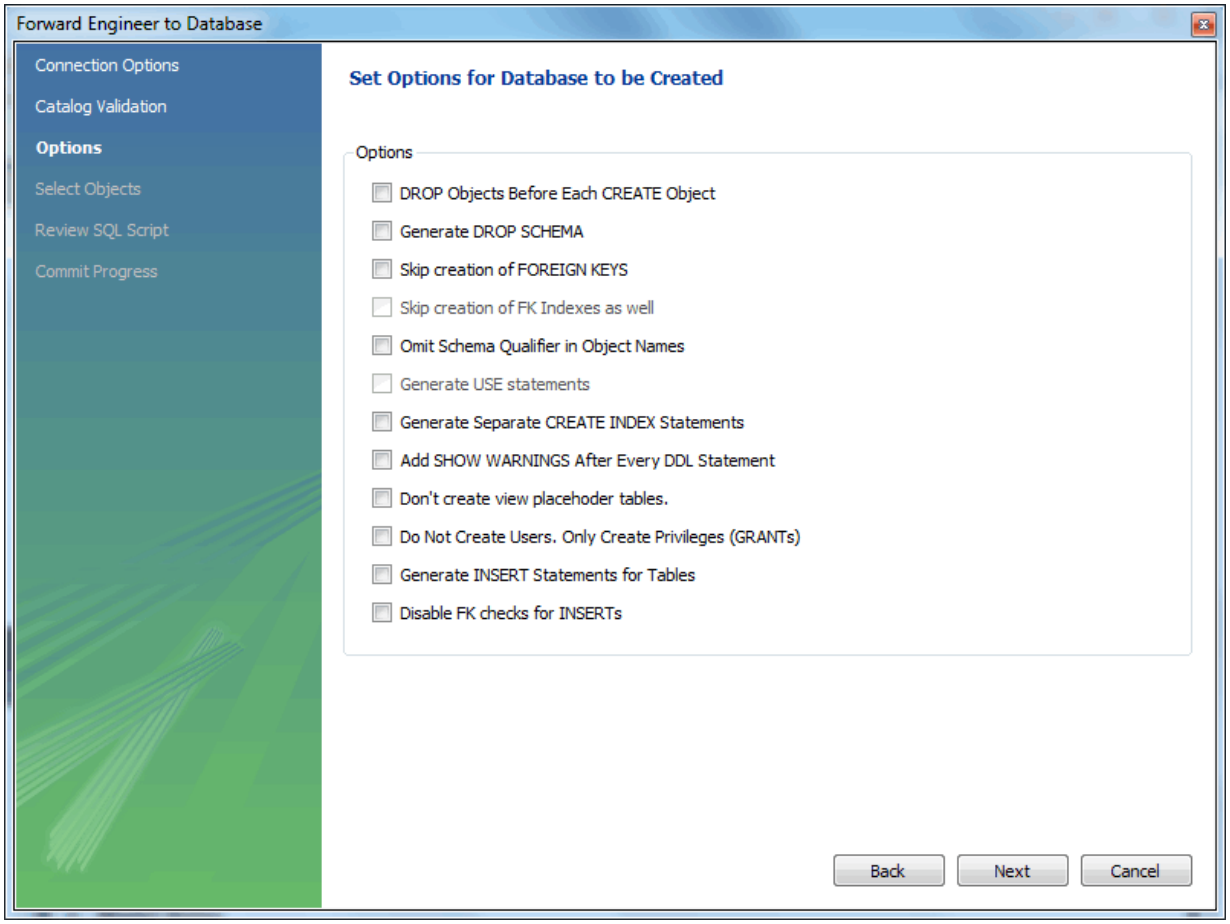
12. The **Connection Options** page selects the MySQL connection and optionally sets additional options for the selected MySQL connection. We do not require connection changes so click Next.

Note

You may decided to choose a different MySQL connection here, but this tutorial uses **MyFirstConnection**.

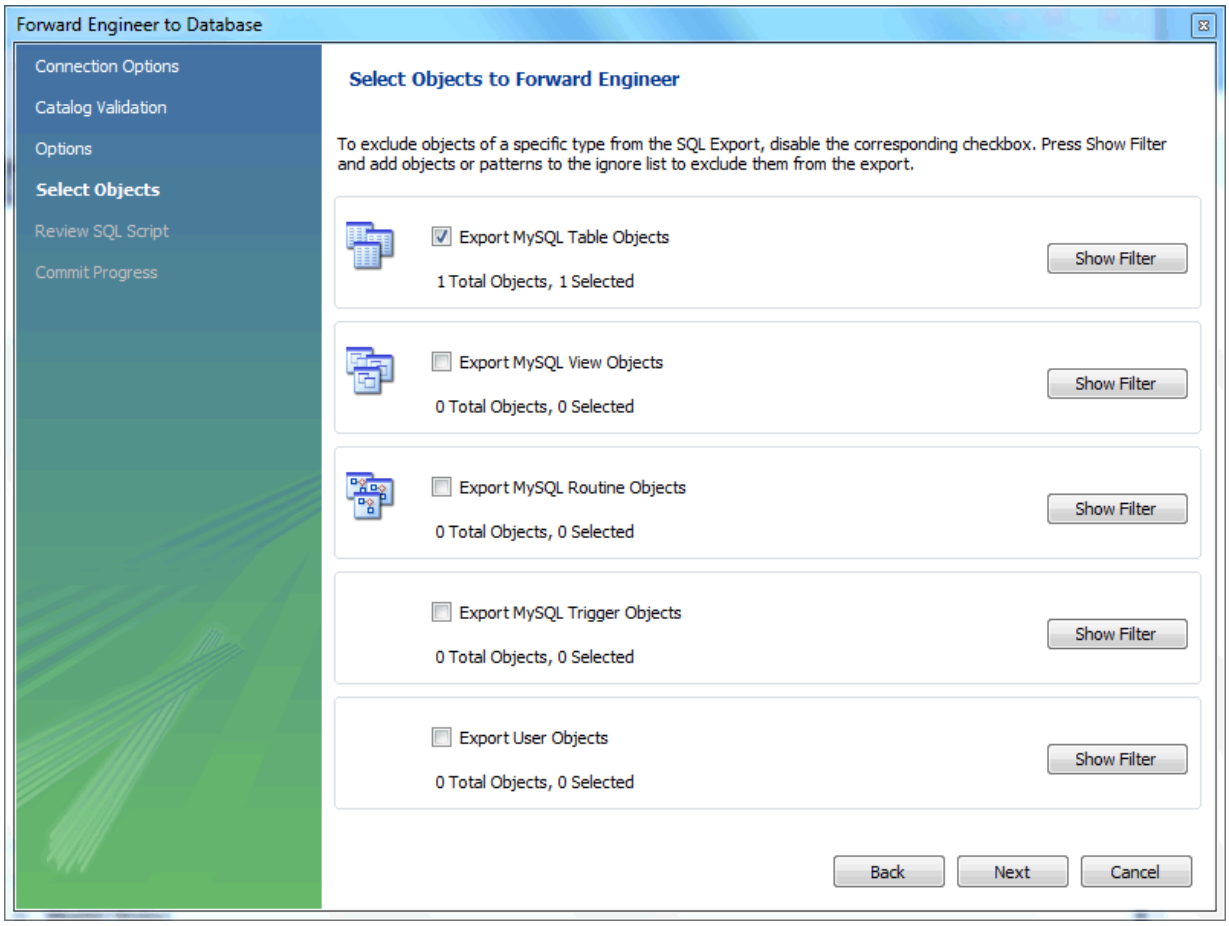
13. The **Options** page lists optional advanced options. For this tutorial, you can ignore these and click **Next**.

Figure 9.20 Getting Started Tutorial - Options



14. Select an object to export to the live MySQL server. In this case, we only have one table (dvd_collection), so select `dvd_collection` and click Next.

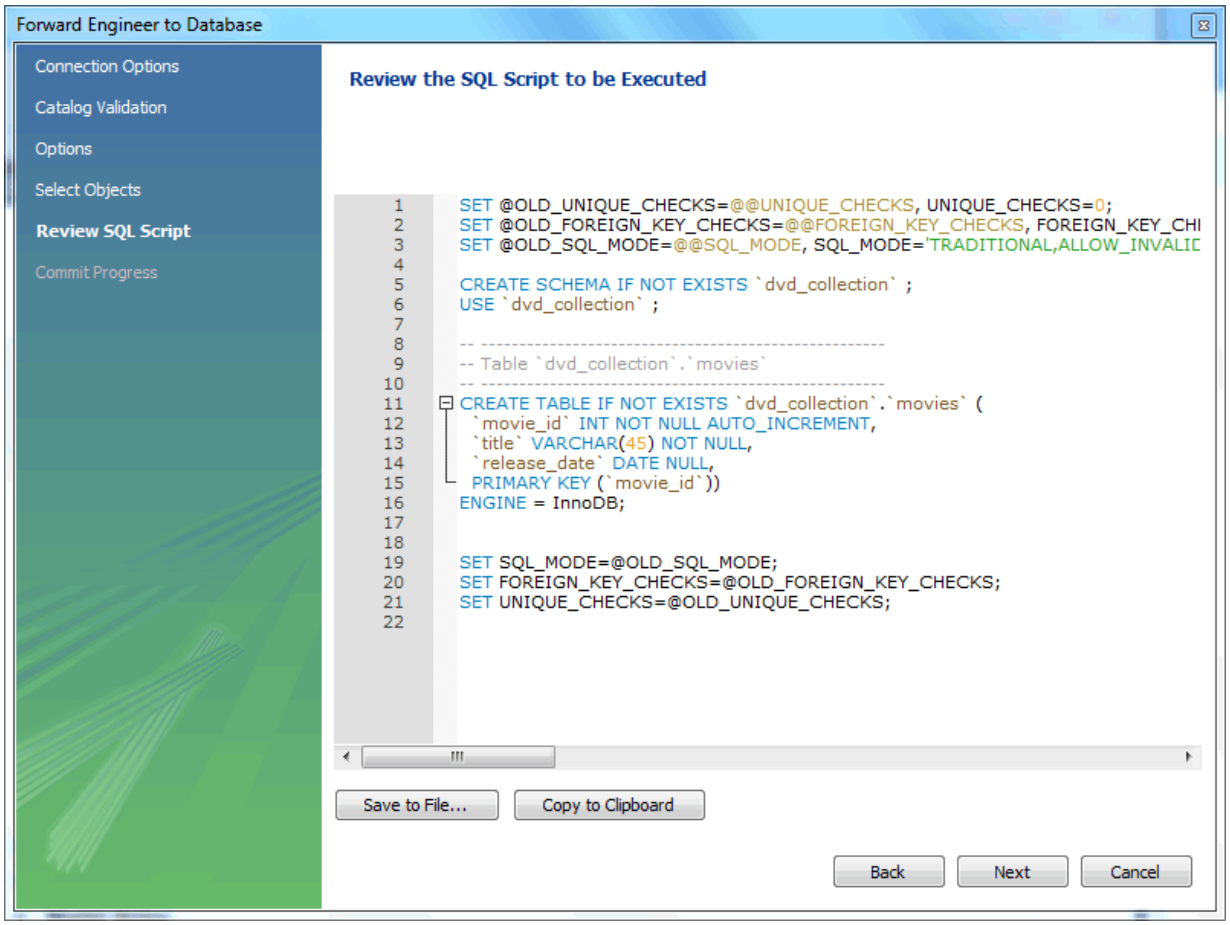
Figure 9.21 Getting Started Tutorial - Select Objects


Forward Engineer to Database
Connection Options
Catalog Validation
Options
Select Objects
Review SQL Script
Commit Progress
Select Objects to Forward Engineer
To exclude objects of a specific type from the SQL Export, disable the corresponding checkbox. Press Show Filter and add objects or patterns to the ignore list to exclude them from the export.
Export MySQL Table Objects
1 Total Objects, 1 Selected
Show Filter
Export MySQL View Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Routine Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Trigger Objects
0 Total Objects, 0 Selected
Show Filter
Export User Objects
0 Total Objects, 0 Selected
Show Filter
Back
Next
Cancel

15. The **Review SQL Script** page displays the SQL script that will be executed on the live server to create your schema. Review the script to make sure that you understand the operations that will be carried out.

    Click Next to execute the Forward Engineering process.

Figure 9.22 Getting Started Tutorial - Review SQL Script



16. The **Commit Progress** page confirms that each step was executed. Click Show Logs to view the logs. If no errors are present, click Close to close the wizard.

17. The new `dvd_collection` database is now present on the MySQL server. Confirm this by opening the MySQL connection and viewing the schema list, or by executing `SHOW DATABASES` from the MySQL Command Line Client (`mysql`).

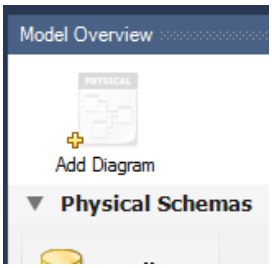
18. Ensure that your model is saved. Click **Save Model to Current File** on the main toolbar.

For additional information about data modeling, see Chapter 9, *Database Design / Modeling*.

9.3.2 Basic Modeling

On the `MySQL Model` page, double-click the **Add Diagram** icon. This creates and opens a new `EER Diagram` canvas.

Figure 9.23 Adding an EER Diagram



From an EER diagram page you can graphically design a database.

9.3.2.1 Adding a Table

The tools in the vertical toolbar on the left of the **EER Diagram** tab are used for designing an EER diagram. Start by creating a table using the table tool. The table tool is the rectangular grid in the middle of the vertical toolbar. Mousing over it shows the message, `Place a New Table (T)`.

Clicking this tool changes the mouse pointer to a hand with a rectangular grid. Create a table on the canvas by clicking anywhere on the `EER Diagram` grid.

Right-click the table and choose Edit in New Window from the pop-up menu. This opens the table editor, docked at the bottom of the application.

The table name defaults to `table1`. Change the name by entering `invoice` into the **Name:** field. Changes here affect the name of the tab in the table editor and the name of the table on the canvas.

Pressing **Tab** or **Enter** while the cursor is in the table name field selects the **Columns** tab of the table editor and creates a default column named `idinvoice`.

Pressing **Tab** or **Enter** again sets the focus on the `Datatype` list with `INT` selected. Notice that a field has been added to the table on the EER canvas.

Pressing **Tab** yet again and the focus shifts to adding a second column. Add a `Description` and a `Customer_id` column. When you are finished, close the table editor, by clicking the `x` button on the top left of the table editor.

9.3.2.2 Creating a Foreign Key

Select the table tool again and place another table on the canvas. Name this table `invoice_item`. Next click the `1:n Non-Identifying Relationship` tool.

First, click the `invoice_item` table; notice that a red border indicates that this table is selected. Next, click the `invoice` table. This creates a foreign key in the `invoice_item` table, the table on the “many” side of the relationship. This relationship between the two tables is shown graphically in crow's foot notation.

Revert to the default mouse pointer by clicking the arrow at the top of the vertical toolbar. Click on the `invoice_item` table and select the **Foreign keys** tab.

Click the **Foreign key Name** field. The referenced table should show in the **Referenced Table** column and the appropriate column in the **Referenced Column** column.

To delete the relationship between two tables, click the line joining the tables and then press **Control +Delete**.

Experiment with the other tools on the vertical toolbar. Delete a relationship by selecting the eraser tool and clicking the line joining two tables. Create a view, add a text object, or add a layer.

Save your changes to a `MySQL Workbench Models` file (`mwb` extension) by choosing Save from the File menu or by using the keyboard command **Control+S**.

9.3.3 Importing a Data Definition SQL Script

For this tutorial, use the `sakila` database script, which you can find by visiting the http://dev.mysql.com/doc/ page, selecting the `Other Docs` tab, and looking in the `Example Databases` section

After downloading the file, extract it to a convenient location. Open MySQL Workbench and find the Reverse Engineer MySQL Create Script menu item by first choosing File and then Import. Find and import the `sakila-schema.sql` file. This is the script that contains the data definition statements for the `sakila` database. The file filter for the file open dialog window defaults to `*.sql` so you should be able to view only files with the `sql` extension.

If the file was successfully imported, the application's status bar reads, `Import MySQL Create Script done.` To view the newly imported script, expand the `Physical Schemata` section by double-clicking the arrow on the left of the `Physical Schemata` title bar. Select the tab labeled **sakila**.

You may also wish to remove the default schema tab, `mydb`. Select this tab, then click the `-` button on the upper right in the **Physical Schemata** panel.

To view all the objects in the `sakila` schema, you may need to expand the **Physical Schemata** window. Move the mouse pointer anywhere over the gray area that defines the lower edge of the **Physical Schemata** window. Hold down the right mouse button and move the mouse to adjust the size of the window.

After you have expanded the window, all the objects in the `sakila` database should be visible. Tables appear at the top followed by views and then routines. There are no routine groups in this schema, but you should see the **Routine Groups** section and an `Add Group` icon.

For a complete description of importing a MySQL create script, see Section 9.4.2.1, “Reverse Engineering Using a Create Script”.

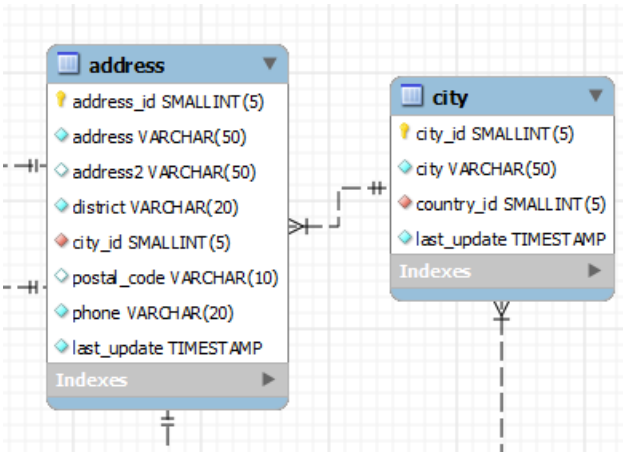
9.3.3.1 Adding an EER Diagram

To create an EER diagram for the `sakila` database, first add an EER diagram by double-clicking the `Add Diagram` icon in the **EER Diagrams** panel to create and open a new `EER Diagram` editor.

The `EER Diagram` canvas is where object modeling takes place. To add a table to the canvas, select the **Catalog** tab in the middle panel on the right side of the application to display any schemata that appear in the **MySQL Model** tab. Find the `sakila` schema and expand the view of its objects by clicking the `+` button to the left of the schema name. Expand the tables list in the same way.

You can add tables to the EER canvas by dragging them from the **Catalog** panel dropping them onto the canvas. Drop the `address` table and the `city` table onto the canvas.

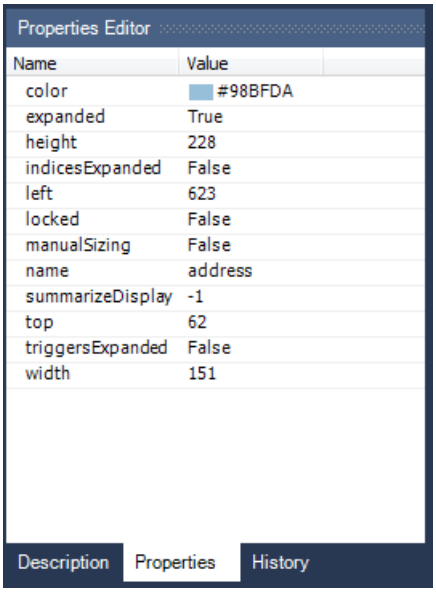
Figure 9.24 Adding Tables to the Canvas



MySQL Workbench automatically discovers that `address.city_id` has been defined as a foreign key referencing the `city.city_id` field. Drop the `country` table onto the canvas and immediately you should see the relationship between the `country` table and the `city` table. (To view all the relationships in the `sakila` database, see Figure 9.29, “The sakila Database EER Diagram”.)

Click the **Properties** tab of the panel on the lower left, then click one of the tables on the canvas. This displays the properties of the table in the `Properties` window. While a table is selected, you can use the `Properties` window to change a table's properties. For example, entering `#FF0000` for the color value will change the color accent to red.

Figure 9.25 Viewing The Properties



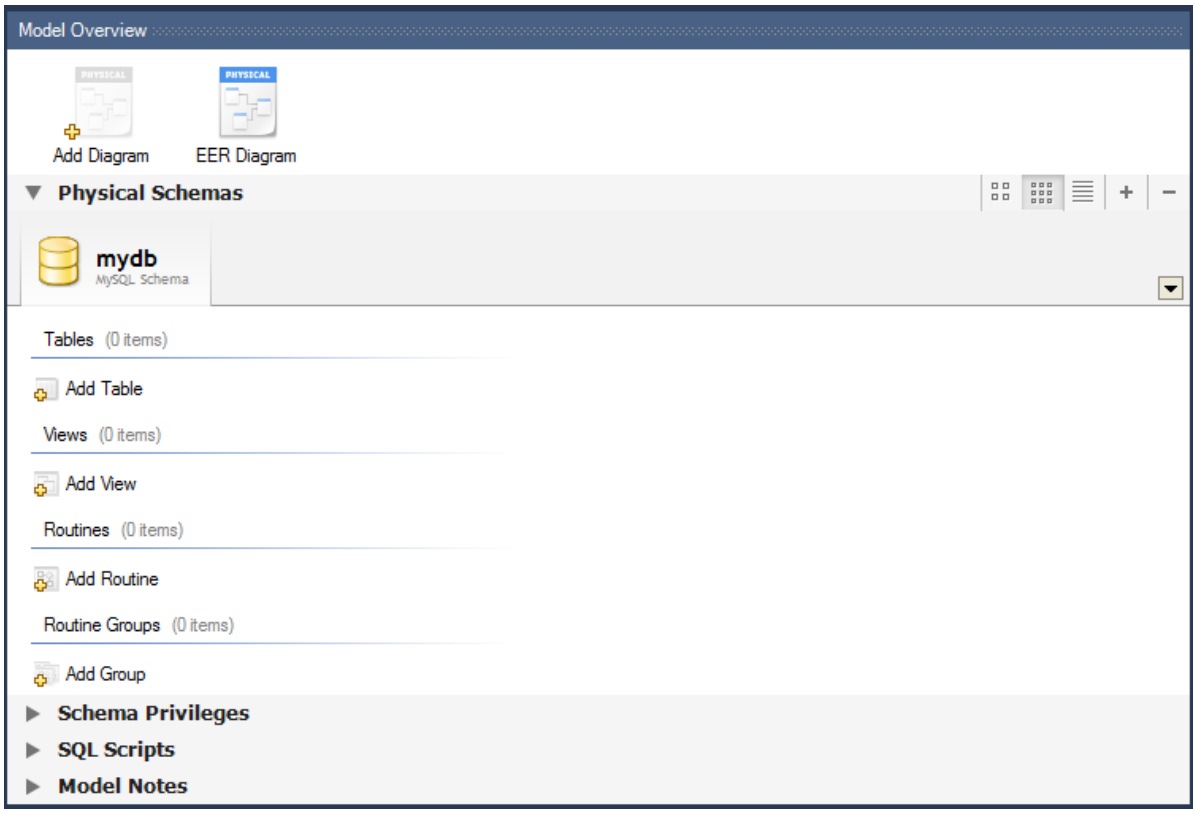
Changing the color of a table is a good way to identify a table quickly—something that becomes more important as the number of tables increases. Changing the color of a table is also an easy way to identify a table in the `Model Navigator` panel. This panel, the uppermost panel on the left side of the page, gives a bird's eye view of the entire EER canvas.

Save your changes to a `MySQL Workbench Models` file (`mwb` extension) by choosing Save from the File menu or by using the keyboard command **Control** + **S**.

9.3.4 Using the Default Schema

When you first open MySQL Workbench a default schema, `mydb` appears as the leftmost tab of the **Physical Schemata** section of MySQL Workbench. You can begin designing a database by using this default schema.

Figure 9.26 The Default Schema



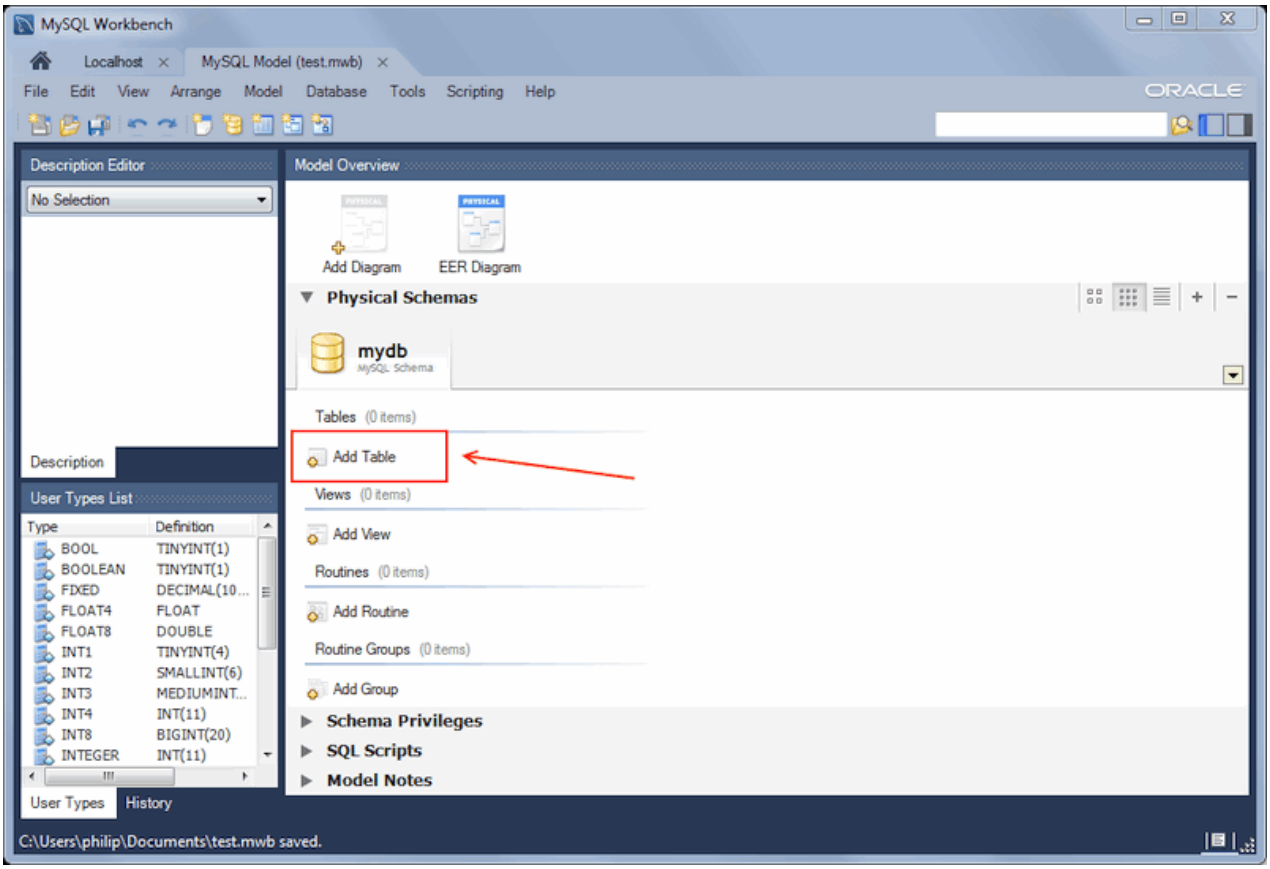
To change the name of the default schema, double-click the schema tab. This opens a schema editor window docked at the bottom of the application. To undock or redock this window, double-click anywhere in the editor title bar.

To rename the schema, use the field labeled **Name**. After you have renamed the schema, a lightning bolt icon appears right aligned in the **Name** field, indicating that other changes are pending. Click the **Comments** field and a dialog box opens asking if you wish to rename all schema occurrences. Clicking Yes ensures that your changes are propagated throughout the application. Add comments to the database and change the collation if you wish. Close the schema editor by clicking the `x` button.

9.3.4.1 Creating a New Table

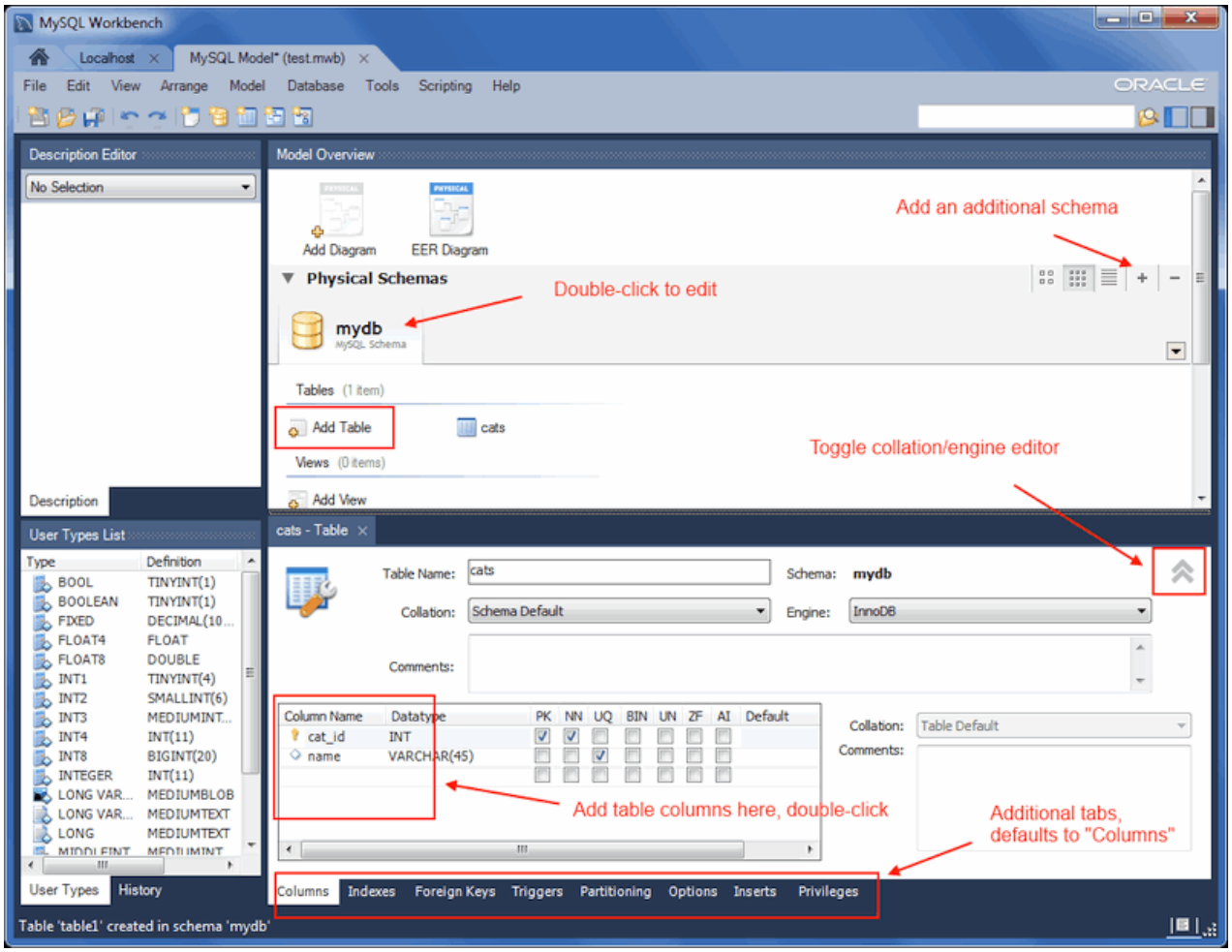
Create a new table by double-clicking the **Add Table** icon in the `Physical Schemata` panel. This opens the table editor docked at the bottom of the application. If you wish, you can undock or dock this editor in exactly the same way as the schema editor window.

Figure 9.27 Model: Creating A New Table



Initially, the table name defaults to 'table1' in the table editor. The following screenshot describes the available actions:

Figure 9.28 Model: Editing Table Values



In our example above, columns were added using the **Columns** tab. Clicking an empty row will add a new column, and clicking an existing column starts edit mode. Click the **Tab** key to move to the next column and set the column's data type.

Altering the table by adding indexes or other features is also possible using the table editor by clicking each tab within the table editor.

9.3.4.2 Creating Other Schema Objects

Additional objects such as views or routines can be added in the same way as tables.

Objects are listed under the **Catalog** palette on the right. To view these schema objects, select the **Catalog** tab in the middle palette on the right. View all the objects by clicking the + button to the left of the schema name.

Save your changes to a `MySQL Workbench Models` file (`mwb` extension) by choosing Save from the File menu or by using the keyboard command **Control+S**.

9.3.5 Documenting the sakila Database

This chapter highlights the capabilities of MySQL Workbench as a documentation tool using the `sakila` database as an example. This is a sample database provided by MySQL that you can find by visiting the

http://dev.mysql.com/doc/ page, selecting the `Other Docs` tab, and looking in the `Example Databases` section

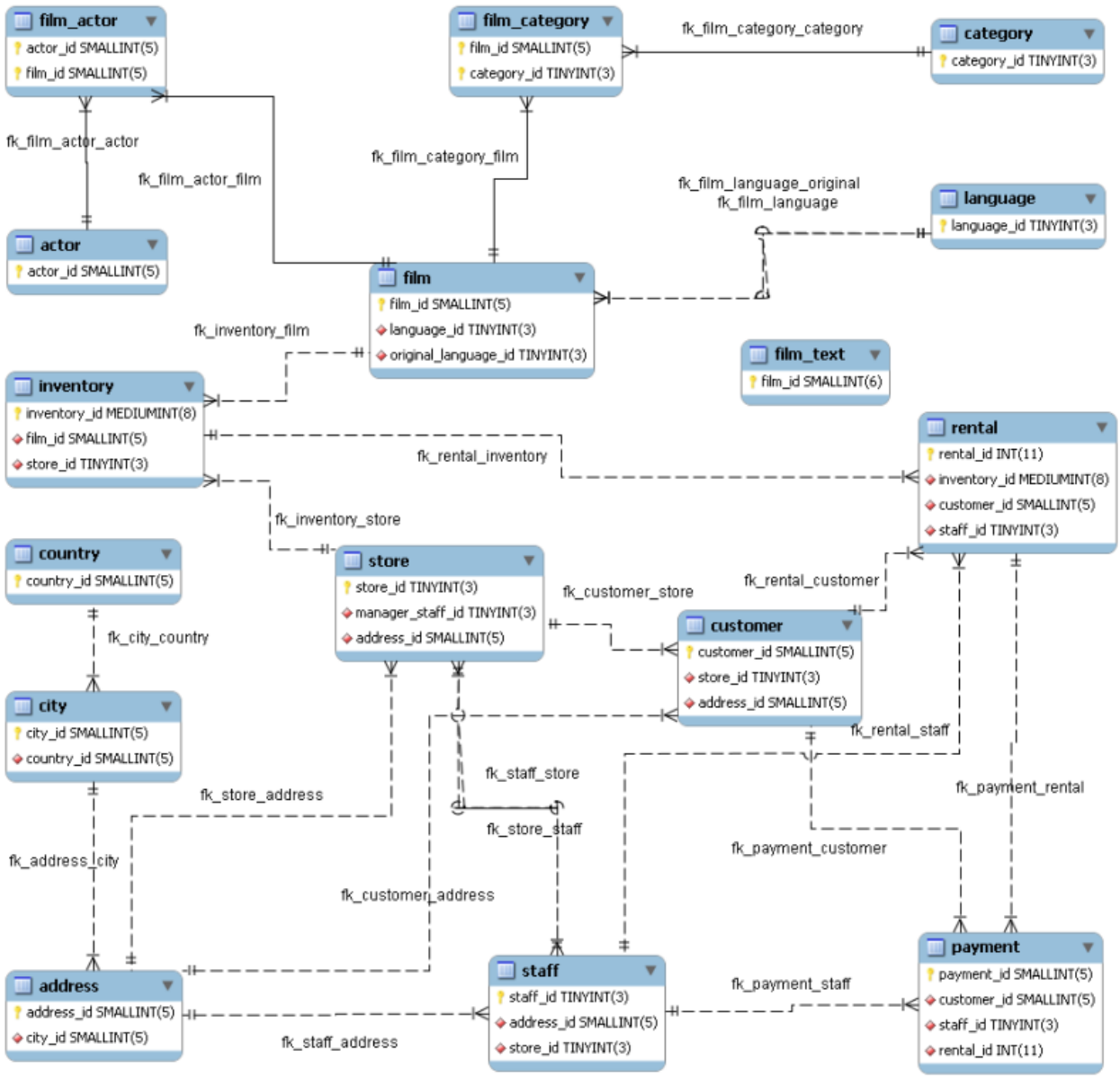
An EER diagram provides a quick overview and understanding of a database. Rather than reading through table definition statements, a quick glance at an EER diagram indicates how tables are related.

You can also see how tables are related; what the foreign keys are and what the nature of the relationship is.

9.3.5.1 A PNG File of the sakila Database

Find following an EER diagram showing all the tables in the `sakila` database. This image was created using the File, Export, Export as PNG... menu item.

Figure 9.29 The sakila Database EER Diagram



The object notation style used in Figure 9.29, “The sakila Database EER Diagram” is `Workbench (PKs only)`. This notation shows only primary keys and no other columns, which is especially useful where space is at a premium. The relationship notation is the default, Crow's Foot.

As the connection lines show, each table is related to at least one other table in the database (with the exception of the `film_text` table). Some tables have two foreign keys that relate to the same table. For example the `film` table has two foreign keys that relate to the `language` table, namely `fk_film_language_original` and `fk_film_language`. Where more than one relationship exists between two tables, the connection lines run concurrently.

Identifying and nonidentifying relationships are indicated by solid and broken lines respectively. For example, the foreign key `category_id` is part of the primary key in the `film_category` table so its relationship to the `category` table is drawn with a solid line. On the other hand, in the `city` table, the foreign key, `country_id`, is not part of the primary key so the connection uses a broken line.

9.4 Forward and Reverse Engineering

MySQL Workbench provides capabilities to forward engineering physical database designs. A visual data model can be transformed into a physical database on a target MySQL Server by executing the forward engineering wizard. All SQL code is automatically generated to help eliminate the normal error-prone process of manually writing complex SQL code. MySQL Workbench also enables you to reverse engineer an existing database or packaged application to get better insight into its database design. In addition to forward and reverse engineering existing databases, it can also import SQL scripts to build models, and export models to DDL scripts to execute at a later time.

9.4.1 Forward Engineering

It is possible to forward engineer a database using an SQL script or by connecting to a live database.

9.4.1.1 Forward Engineering Using an SQL Script

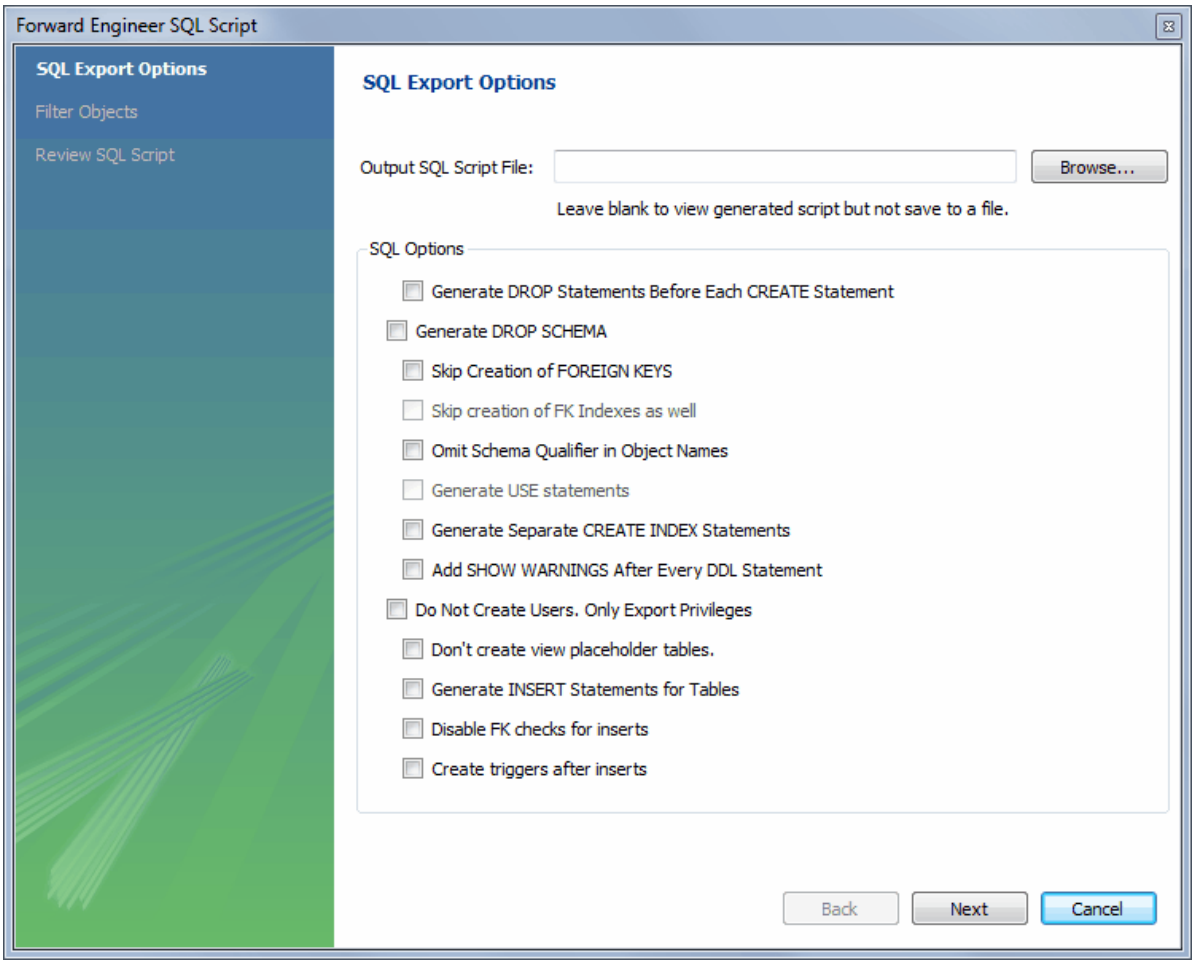
To create a script of your database model, choose the Export item from the File menu. You may export a script to alter an existing database or create a new database. The script to create a database is similar to the one created using the `mysqldump` *`db_name`* command.

Choosing to create a database yields additional options.

Creating a Schema

Select the File, Export, Forward Engineer SQL CREATE Script menu item to start the Forward Engineer SQL Script wizard. The following figure shows the first page of the wizard.

Figure 9.30 SQL Export Options


Forward Engineer SQL Script
SQL Export Options
Filter Objects
Review SQL Script
SQL Export Options
Output SQL Script File:
Browse...
Leave blank to view generated script but not save to a file.
SQL Options
Generate DROP Statements Before Each CREATE Statement
Generate DROP SCHEMA
Skip Creation of FOREIGN KEYS
Skip creation of FK Indexes as well
Omit Schema Qualifier in Object Names
Generate USE statements
Generate Separate CREATE INDEX Statements
Add SHOW WARNINGS After Every DDL Statement
Do Not Create Users. Only Export Privileges
Don't create view placeholder tables.
Generate INSERT Statements for Tables
Disable FK checks for inserts
Create triggers after inserts
Back
Next
Cancel

The SQL Export Options displays the following facilities:

- `Output SQL Script File`

  To specify the output file name, enter it into the **Output SQL Script File** field, or use the Browse button to select a file. Leave this field blank to view, but not save, the generated output.

- `Generate DROP Statements Before Each CREATE Statement`

  Select this option to generate a statement to drop each object before the statement that creates it. This ensures that any existing instance of each object is removed when the output is executed.

- `Generate DROP SCHEMA`
- `Skip creation of FOREIGN KEYS`
- `Skip creation of FK Indexes as well`
- `Omit Schema Qualifier in Object Names`

  Select this option to generate unqualified object names in SQL statements.

- `Generate USE statements`

- `Generate Separate CREATE INDEX Statements`

  Select this option to create separate statements for index creation instead of including index definitions in `CREATE TABLE` statements.

- `Add SHOW WARNINGS after every DDL statement`

  Select this option to add `SHOW WARNINGS` statements to the output. This causes display of any warnings generated when the output is executed, which can be useful for debugging.

- `Do Not Create Users. Only Export Privileges`

  Select this option to update the privileges of existing users, as opposed to creating new users. Exporting privileges for nonexistent users will result in errors when you execute the `CREATE` script. Exporting users that already exist will also result in an error.

- `Don't create view placeholder tables`

- `Generate INSERT Statements for Tables`

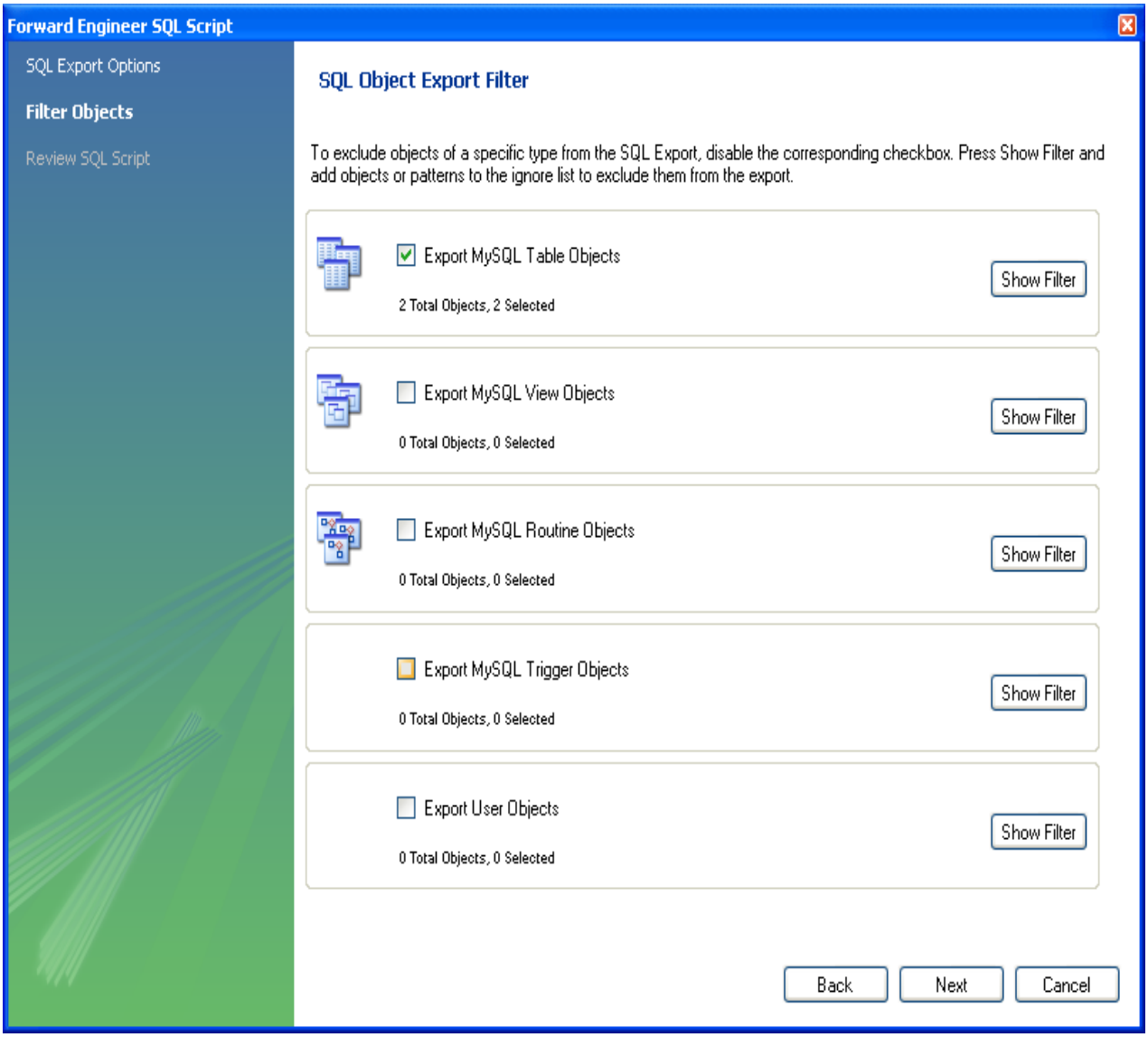
  Select this option if you have added any rows to a table. For more information about inserting rows, see Section 8.1.1, “SQL Query Window”.

- `Disable FK checks for inserts`

- `Create triggers after inserts`

Clicking Next takes you to the **SQL Object Export Filter** page where you select the objects you wish to export.

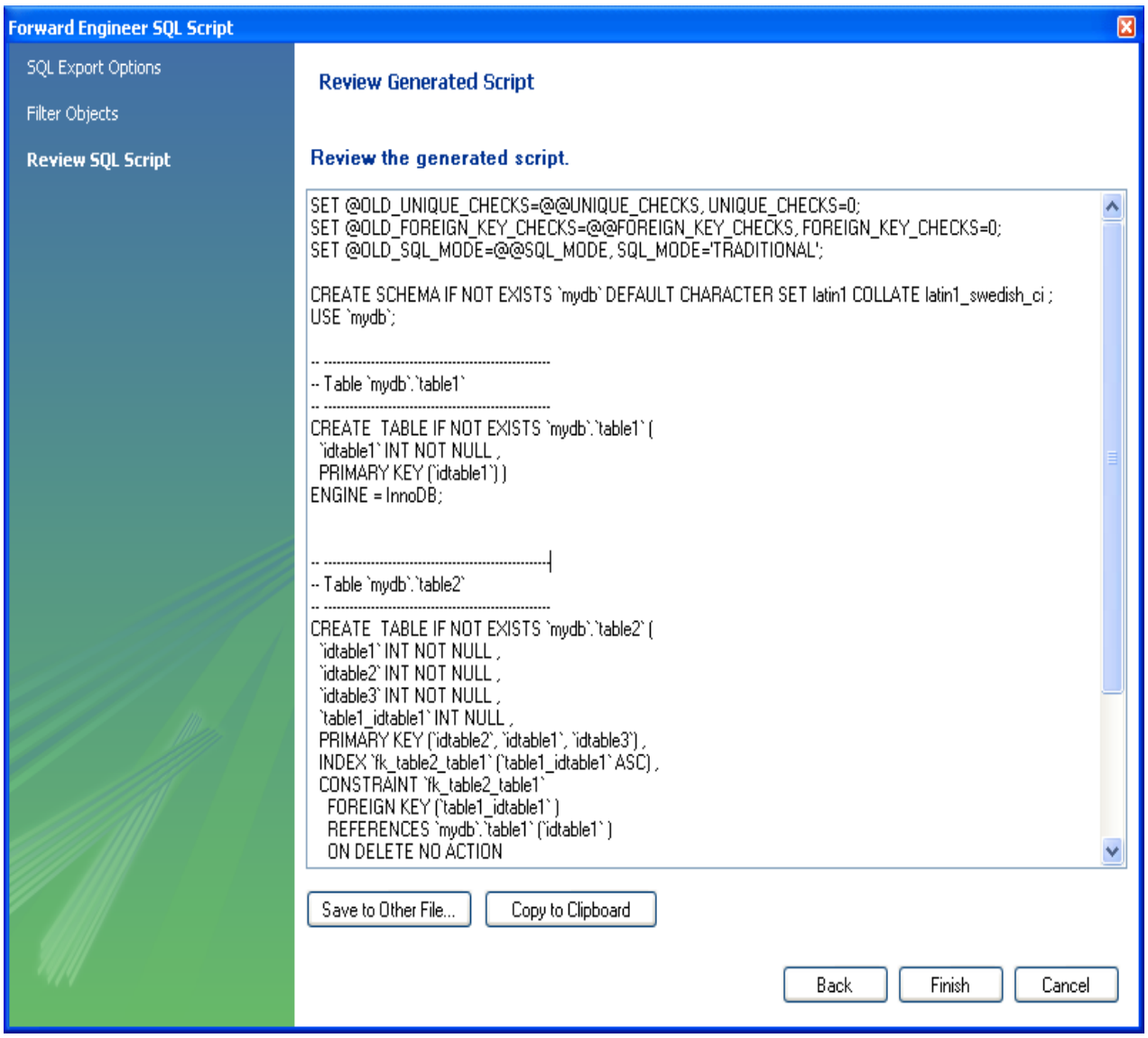
Figure 9.31 SQL Object Export Filter


Forward Engineer SQL Script
SQL Export Options
Filter Objects
Review SQL Script
SQL Object Export Filter
To exclude objects of a specific type from the SQL Export, disable the corresponding checkbox. Press Show Filter and add objects or patterns to the ignore list to exclude them from the export.
Export MySQL Table Objects
2 Total Objects, 2 Selected
Show Filter
Export MySQL View Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Routine Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Trigger Objects
0 Total Objects, 0 Selected
Show Filter
Export User Objects
0 Total Objects, 0 Selected
Show Filter
Back
Next
Cancel

Use Show Filter to fine tune (filter) the objects for export. After selecting the objects to export, click Hide Filter to hide the filter panel.

After selecting the objects to export, click Next to review the generated script.

Figure 9.32 Review Generated Script



You may return to the previous page using the Back button.

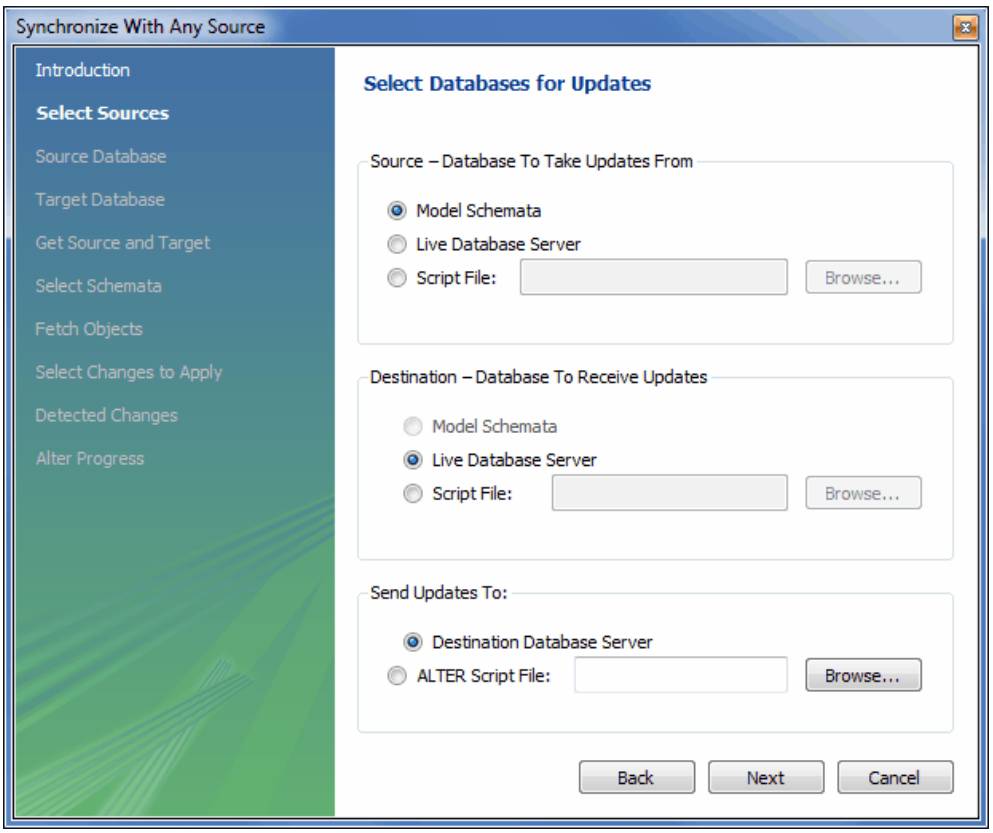
The Finish button saves the script file and exits. You can then use the saved script to create a database.

Altering a Schema

The menu item for creating an **ALTER Script File** is Database, Synchronize With Any Source. Typically, this option is used when the SQL script of a database has been imported into MySQL Workbench and changed, and then you want to create a script that can be executed against the database to alter it to reflect the adjusted model. For instructions on importing a DDL script, see Section 9.4.2.1, “Reverse Engineering Using a Create Script”.

Select the Database, Synchronize With Any Source menu item to start the wizard. You will be presented with the first page showing the introduction, and then the available options:

Figure 9.33 Synchronize With Any Source: Options



For additional information, see Section 9.5.1, “Database Synchronization”.

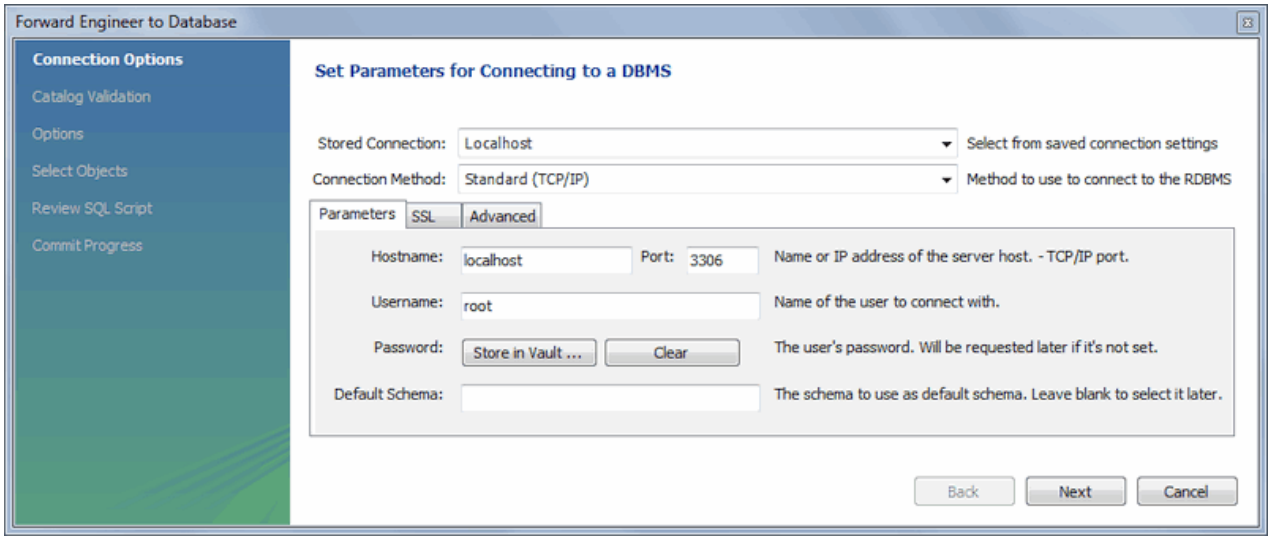
9.4.1.2 Forward Engineering to a Live Server

Use forward engineering to export your schema design to a MySQL server.

Select the model that you wish to forward engineer and then choose the Database, Forward Engineer... menu item from the main menu.

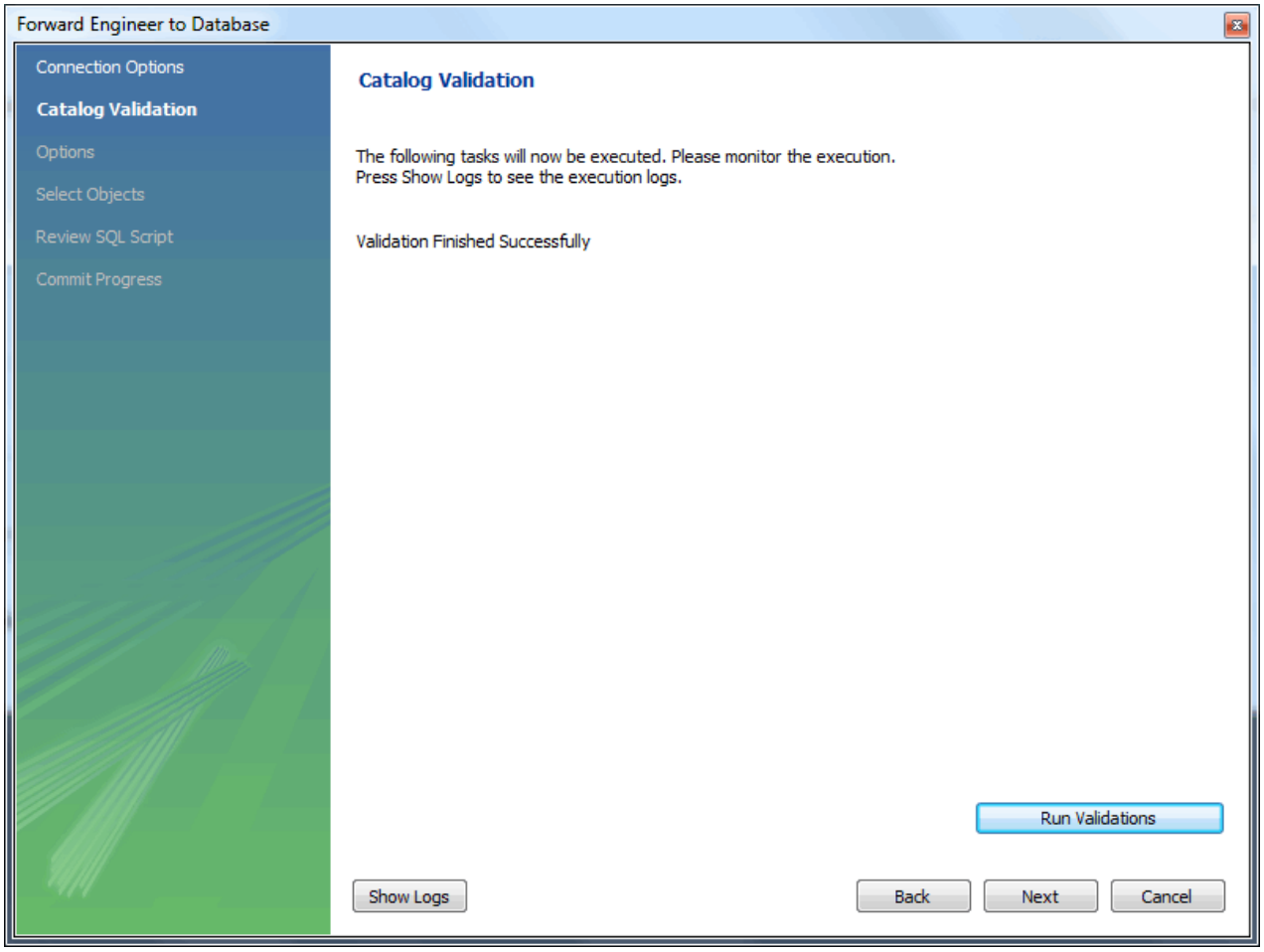
The first step of the process is to connect to a MySQL server to create the new database schema. This page enables you to use a previously stored connection, or enter the connection parameters.

Figure 9.34 Set Parameters for Connecting to a DBMS



Click Next after setting the connection parameters. The next page of the wizard displays is Catalog Validation (validation is available only in the Commercial Edition).

Figure 9.35 Catalog Validation

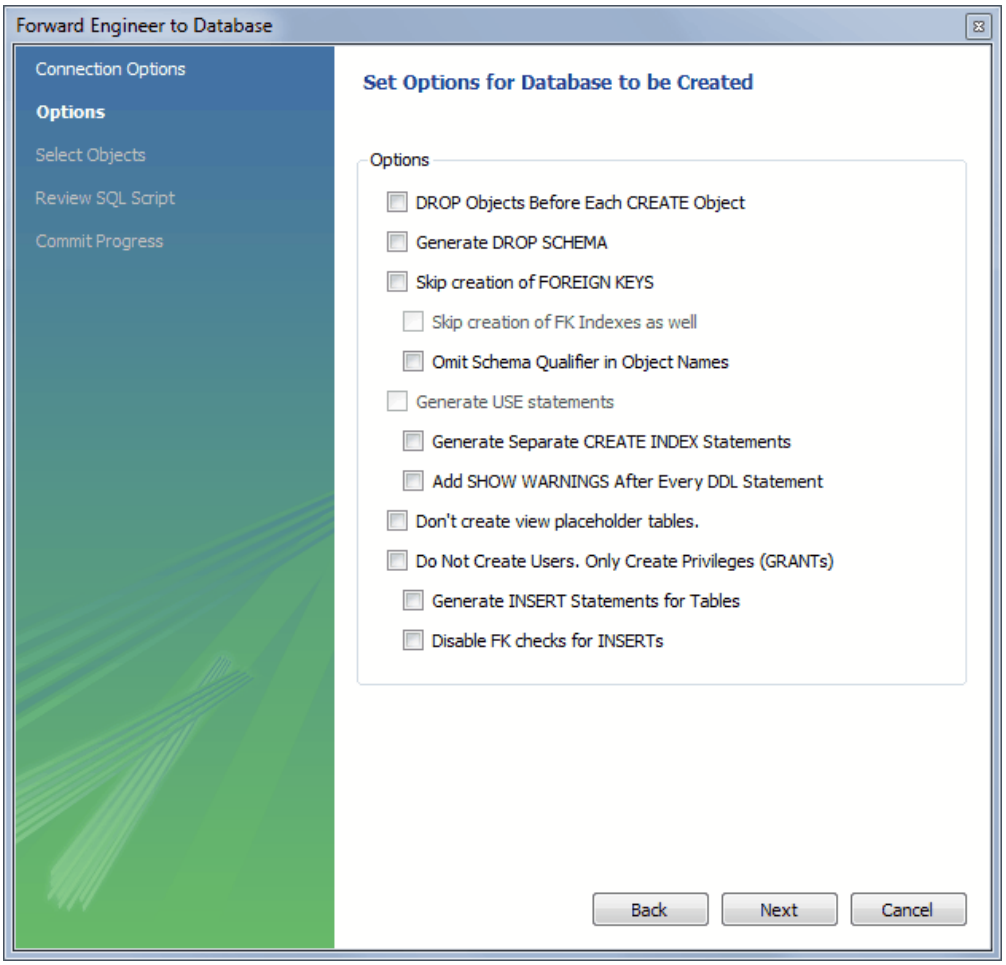


Click Run Validations to validate the catalog.

Click Next to continue.

The next page enables you to set options for the database to be created. These options are as described in Creating a Schema.

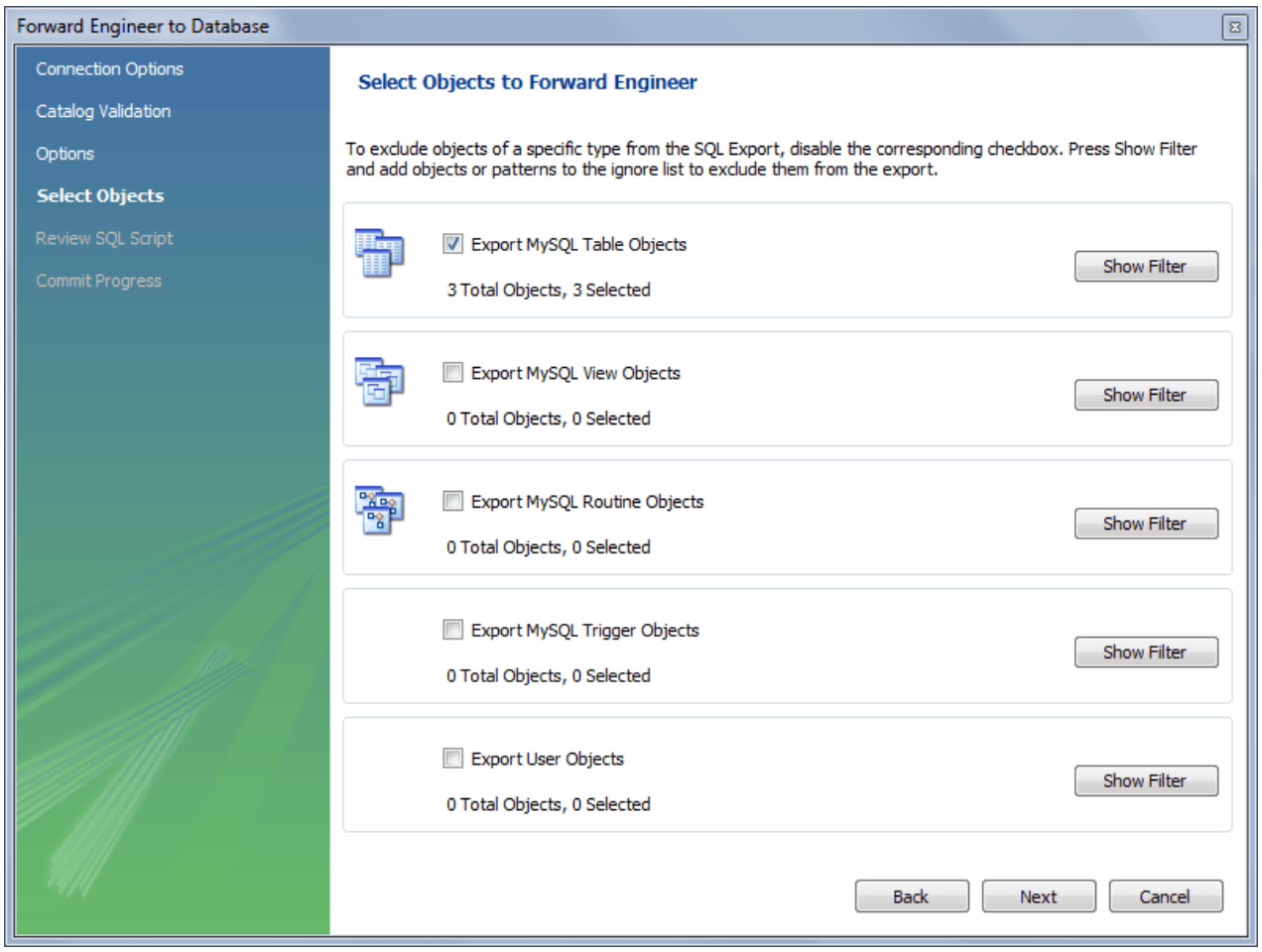
Figure 9.36 Options



Select the required options and then click Next.

The next page enables you to select the objects to forward engineer.

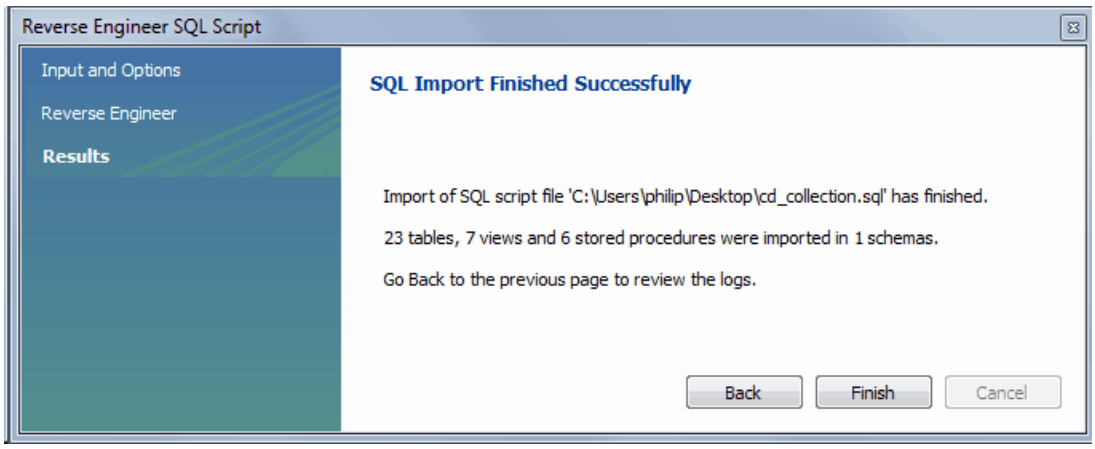
Figure 9.37 Select Objects to Forward Engineer


Forward Engineer to Database
Connection Options
Catalog Validation
Options
Select Objects
Review SQL Script
Commit Progress
Select Objects to Forward Engineer
To exclude objects of a specific type from the SQL Export, disable the corresponding checkbox. Press Show Filter and add objects or patterns to the ignore list to exclude them from the export.
Export MySQL Table Objects
3 Total Objects, 3 Selected
Show Filter
Export MySQL View Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Routine Objects
0 Total Objects, 0 Selected
Show Filter
Export MySQL Trigger Objects
0 Total Objects, 0 Selected
Show Filter
Export User Objects
0 Total Objects, 0 Selected
Show Filter
Back
Next
Cancel

To select a subset of objects to forward engineer, use the Show Filter/Hide Filter button, then select specific objects. After you have selected your objects, click Next to continue

On the **Review Script** page you may review and edit the SQL script that will be executed.

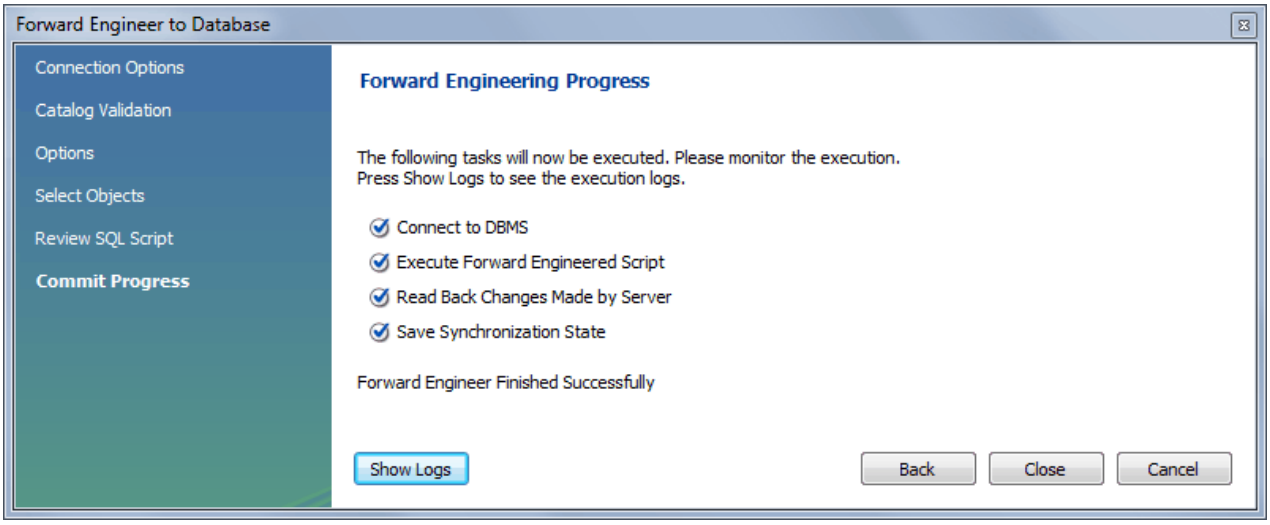
Figure 9.38 Review Script


Reverse Engineer SQL Script
Input and Options
Reverse Engineer
Results
SQL Import Finished Successfully
Import of SQL script file 'C:\Users\philip\Desktop\cd_collection.sql' has finished.
23 tables, 7 views and 6 stored procedures were imported in 1 schemas.
Go Back to the previous page to review the logs.
Back
Finish
Cancel

Click Next to continue if you are satisfied with the generated script.

The next page of the wizard displays the results of the forward engineering process.

Figure 9.39 Forward Engineering Progress



You can confirm that the script created the schema by connecting to the target MySQL server and issuing a `SHOW DATABASES` statement.

9.4.2 Reverse Engineering

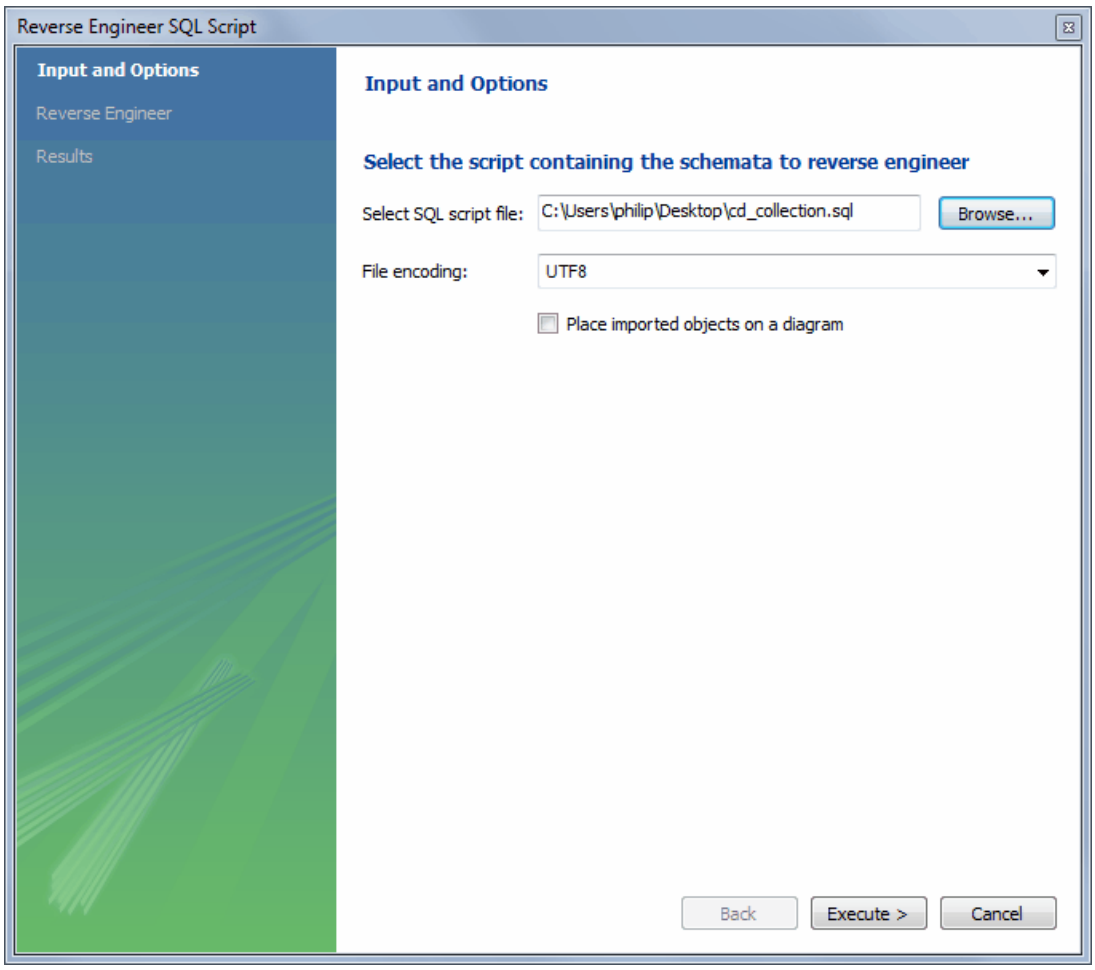
With MySQL Workbench, you can reverse engineer a database using a MySQL create script or you can connect to a live MySQL server and import a single database or a number of databases. All versions of MySQL Workbench can reverse engineer using a MySQL DDL script. Only commercial versions of MySQL Workbench can reverse engineer a database directly from a MySQL server.

9.4.2.1 Reverse Engineering Using a Create Script

To reverse engineer using a create script, choose the File, Import, Reverse Engineer MySQL Create Script... menu item for a model.

Tables, views, routines, routine groups, indexes, keys, and constraints can be imported from an SQL script file. Objects imported using an SQL script can be manipulated within MySQL Workbench the same as other objects.

Figure 9.40 Reverse Engineer SQL Script: Input



- **Select SQL script file**: Open a file open dialog box with the default file type set to an SQL script file, a file with the extension `sql`.
- **File encoding**: Defaults to UTF8.
- **Place imported objects on a diagram**: Also create an EER diagram in MySQL Workbench.

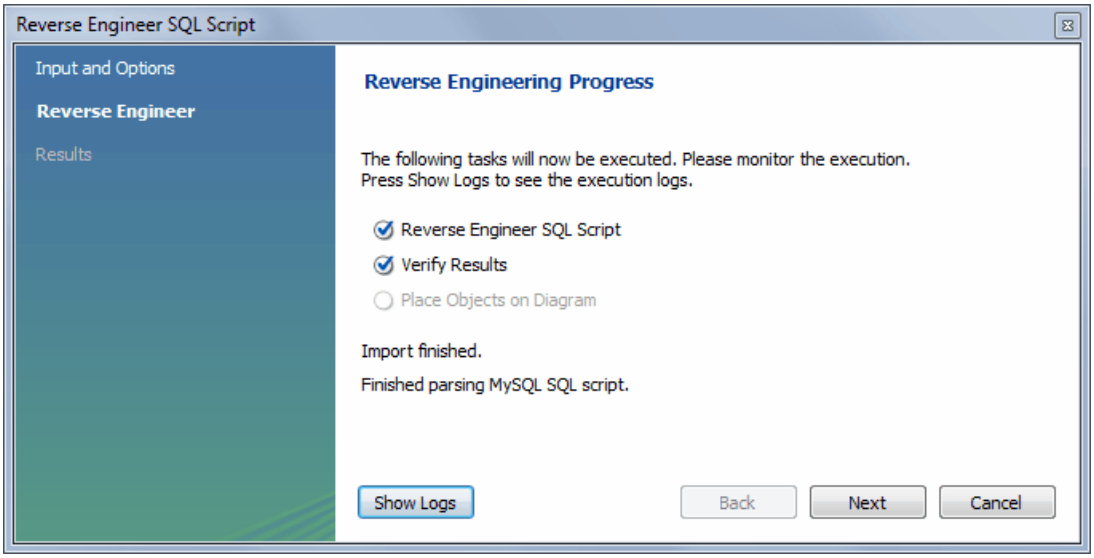
Note

Importing a large number (about 300+) objects could fail to create an EER diagram and instead emit a resource warning with the text "Too many objects are selected for auto placement. Select fewer elements to create the EER diagram." In this case, execute the reverse engineering wizard with this option disabled, manually create the EER diagram, and then import the 300+ objects using the EER diagram catalog viewer.

If your script creates a database, MySQL Workbench creates a new physical schemata tab on the `MySQL Model` page.

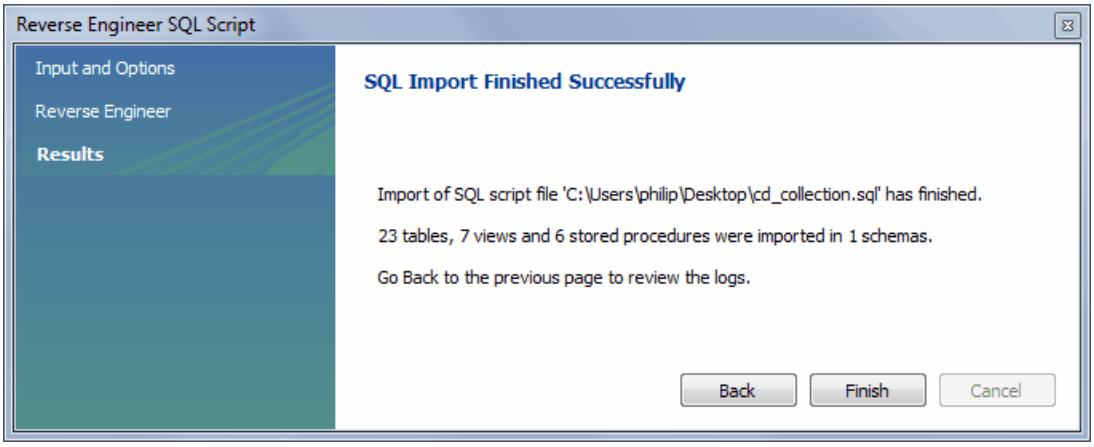
Click Execute to reverse engineer the SQL script, verify its results, and optionally place the objects in a new EER diagram.

Figure 9.41 Reverse Engineer SQL Script: Execution



Click Next to view a summary of the results, and then Finish to close the wizard.

Figure 9.42 Reverse Engineer SQL Script: Results


Reverse Engineer SQL Script
Input and Options
Reverse Engineer
Results
SQL Import Finished Successfully
Import of SQL script file 'C:\Users\philip\Desktop\cd_collection.sql' has finished.
23 tables, 7 views and 6 stored procedures were imported in 1 schemas.
Go Back to the previous page to review the logs.
Back
Finish
Cancel

Before exiting MySQL Workbench, be sure to save the schema. Choose the File, Save menu item and the reverse-engineered database will be saved as a MySQL Workbench file with the extension `mwb`.

See Section 9.3.3, “Importing a Data Definition SQL Script”, for a tutorial on reverse engineering the `sakila` database.

Creating a DDL script

You can create a data definition (DDL) script by executing the **`mysqldump db_name --no-data > script_file.sql`** command. Using the `--no-data` option ensures that the script contains only DDL statements. However, if you are working with a script that also contains DML statements you need not remove them; they will be ignored.

Note

If you plan to redesign a database within MySQL Workbench and then export the changes, be sure to retain a copy of the original DDL script. You will need

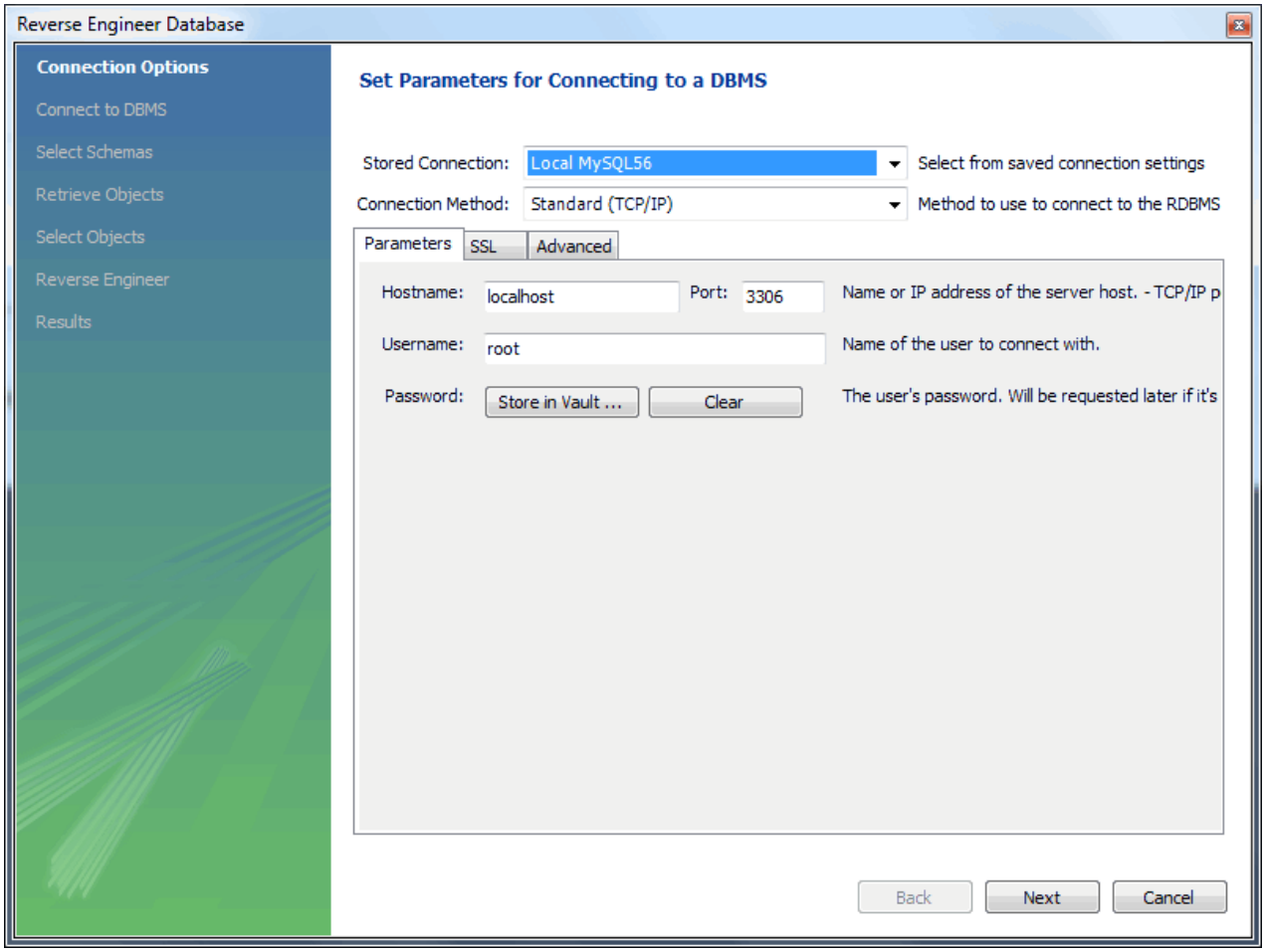
the original script to create an `ALTER` script. For more information, see Altering a Schema.

Use the `--databases` option with `mysqldump` if you wish to create the database as well as all its objects. If there is no `CREATE DATABASE db_name` statement in your script file, you must import the database objects into an existing schema or, if there is no schema, a new unnamed schema is created.

9.4.2.2 Reverse Engineering a Live Database

To reverse engineer a live database, choose the Database, Reverse Engineer... menu item from the main menu. This opens the Reverse Engineer Database wizard.

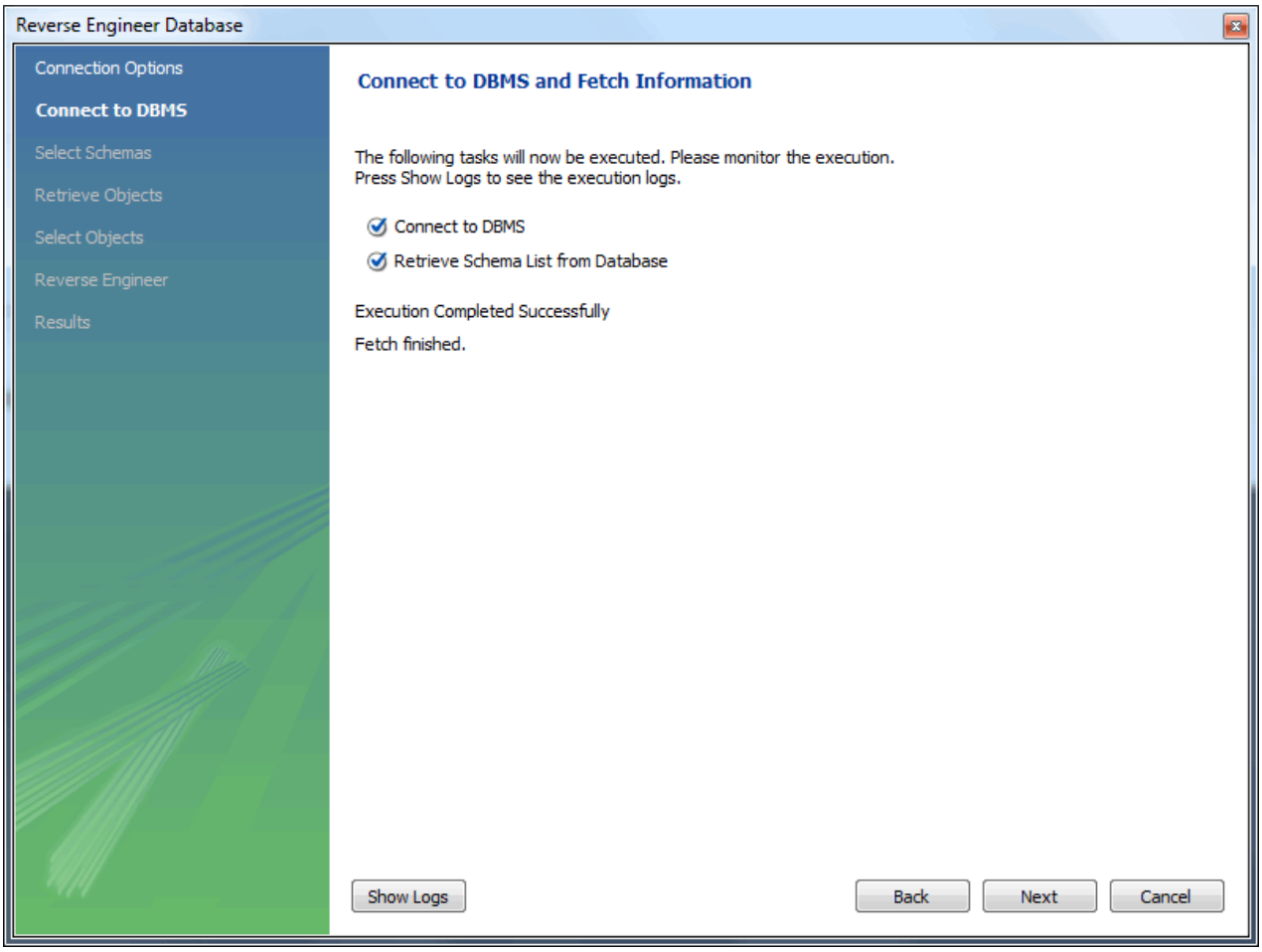
Figure 9.43 Reverse Engineer Database Wizard



The first page of the wizard enables you to set up a connection to the live database you wish to reverse engineer. You can set up a new connection or select a previously created stored connection. Typical information required for the connection includes host name, user name and password.

After this information has been entered, or you have selected a stored connection, click the Next button to proceed to the next page.

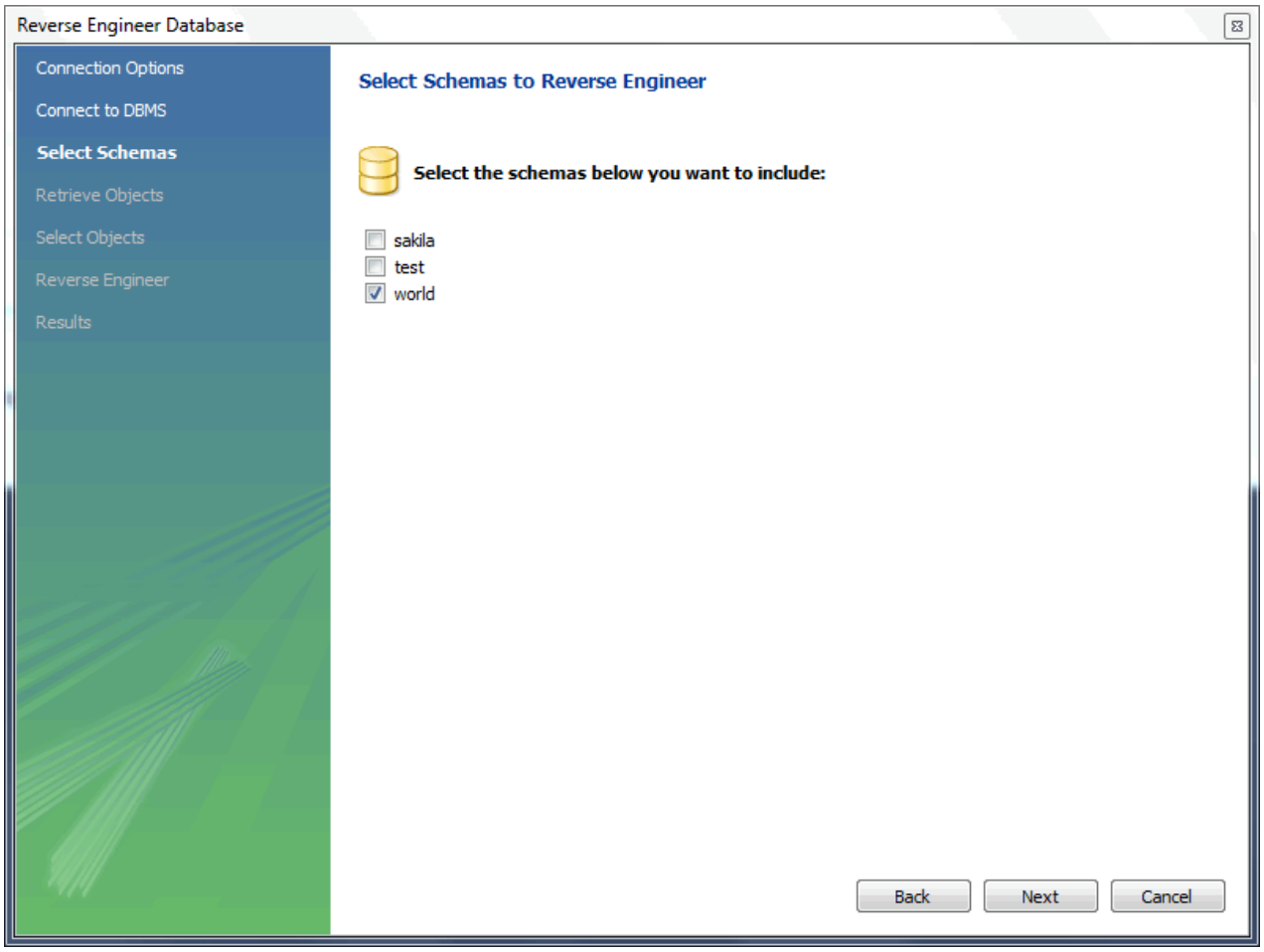
Figure 9.44 Connect to DBMS



Review the displayed information to make sure that the connection did not generate errors, then click Next.

The next page displays the schemata available on the server. Click the check box or check boxes for any schemata you wish to process.

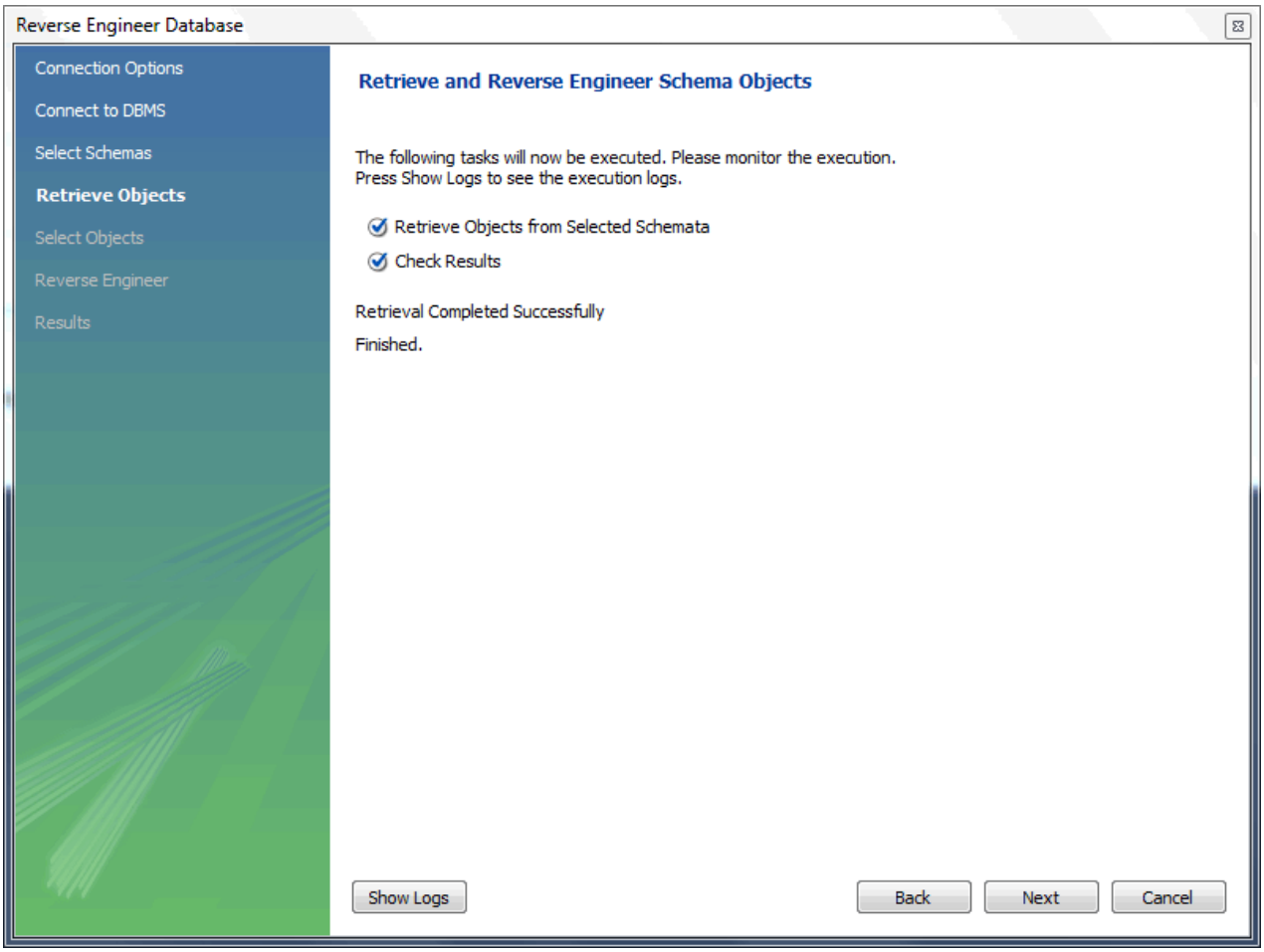
Figure 9.45 Select Schemas



After you have selected the desired schemas, click the Next button to continue.

The wizard then displays the tasks it carried out and summarizes the results of the operation.

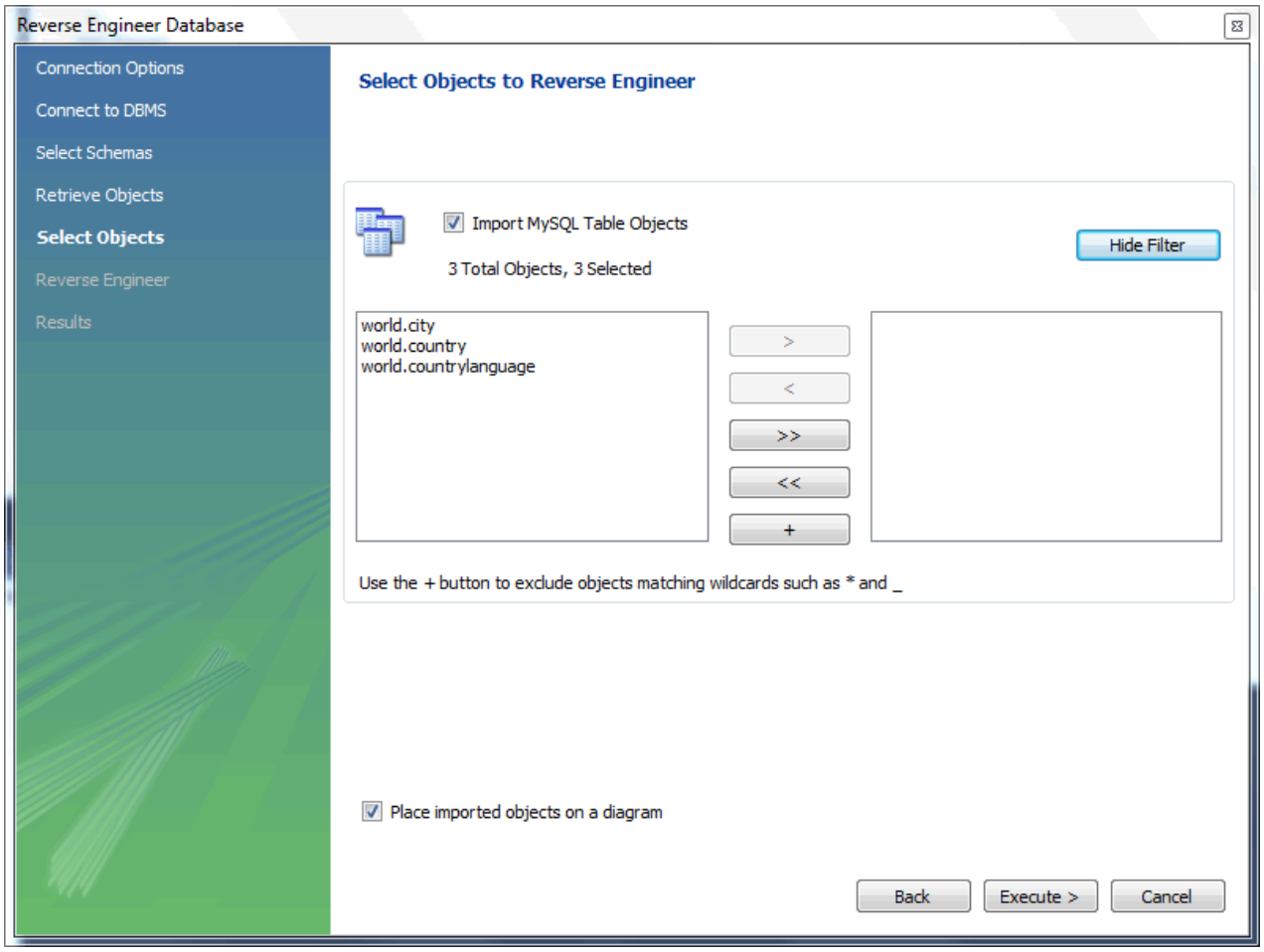
Figure 9.46 Retrieve Objects



Review the results before clicking Next to continue.

The next page is the `Select Objects` page. It has a section for each object type present in the schema (tables, views, routines, and so forth). This page is of special interest if you do not wish to import all the objects from the existing database. It gives you the option of filtering which objects are imported. Each section has a Show Filter button. Click this button if you do not want to import all the objects of a specific type. Here is this page with the filter open:

Figure 9.47 Select Objects



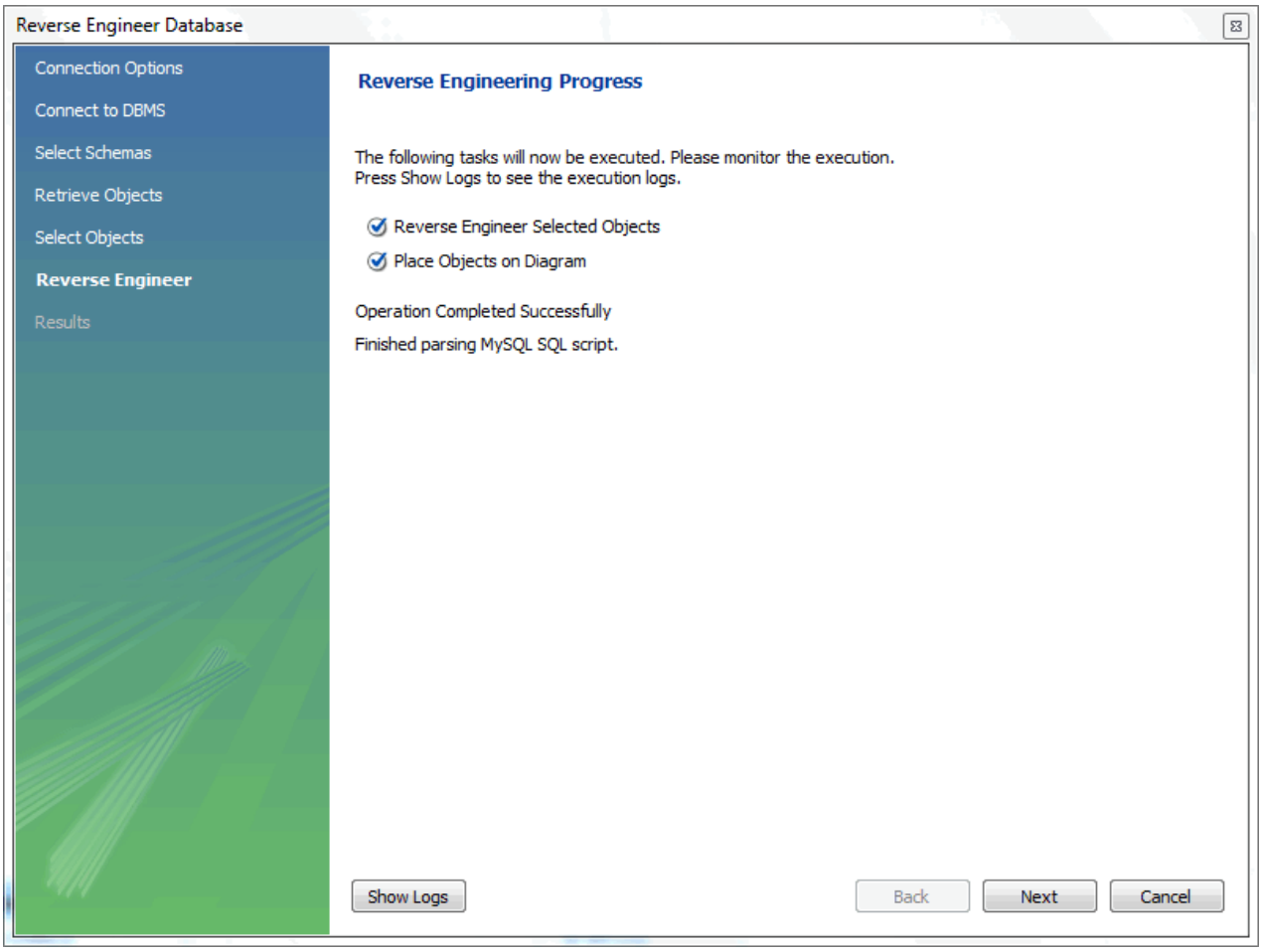
This page enables you to select specific tables for import. Having selected the desired tables, you can optionally hide the filter by clicking the Hide Filter button.

The other sections, such as **MySQL Routine Objects**, have similar filters available.

Click Execute to continue to the next page.

The wizard then imports objects, displaying the tasks that have been carried out and whether the operation was successful. If errors were generated, you can click the Show Logs button to see the nature of the errors.

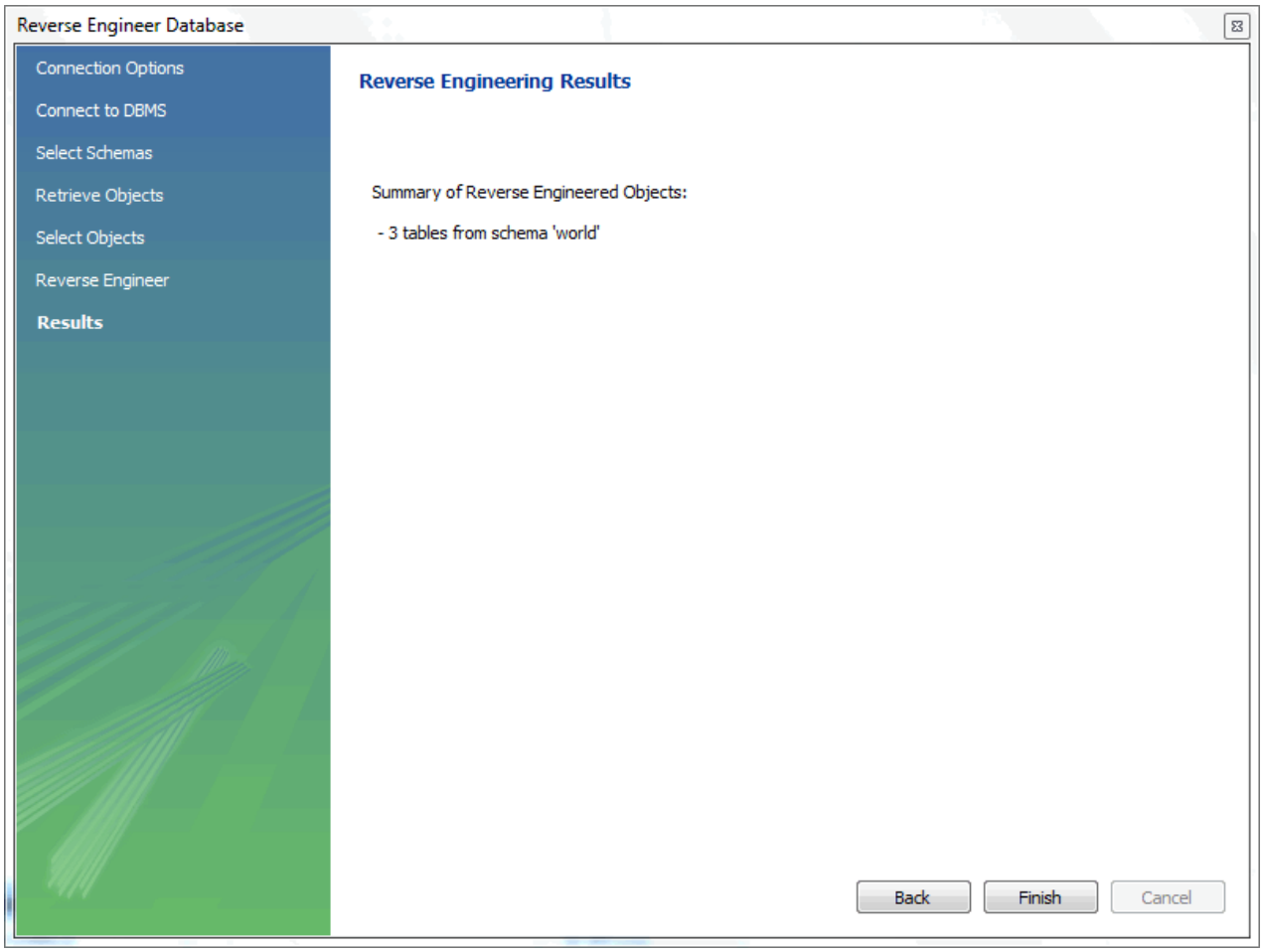
Figure 9.48 Reverse Engineer Progress



Click Next to continue to the next page.

The final page of the wizard provides a summary of the reverse engineered objects.

Figure 9.49 Results



Click Finish to exit the wizard.

Before exiting MySQL Workbench be sure to save the schema. Choose the File, Save menu item to save the reverse-engineered database as a MySQL Workbench file with the extension `mwb`.

Errors During Reverse Engineering

During reverse engineering, the application checks for tables and views that duplicate existing names and disallows duplicate names if necessary. If you attempt to import an object that duplicates the name of an existing object you will be notified with an error message. To see any errors that have occurred during reverse engineering, you can click the button Show Logs. This will create a panel containing a list of messages, including any error messages than may have been generated. Click the Hide Logs button to close the panel.

If you wish to import an object with the same name as an existing object, rename the existing object before reverse engineering.

If you import objects from more than one schema, there will be a tab in the `Physical Schemata` section of the `MySQL Model` page for each schema imported.

You cannot reverse engineer a live database that has the same name as an existing schema. If you wish to do this, first rename the existing schema.

9.5 Schema Synchronization and Comparison

Database change management is a complex process that involves maintaining different versions of database schemas and manually modifying existing databases. To help with this administration task, MySQL Workbench includes schema synchronization and comparison utilities. You can compare two live databases, two models, or models with live databases, to visually see the differences and optionally perform a synchronization routine.

9.5.1 Database Synchronization

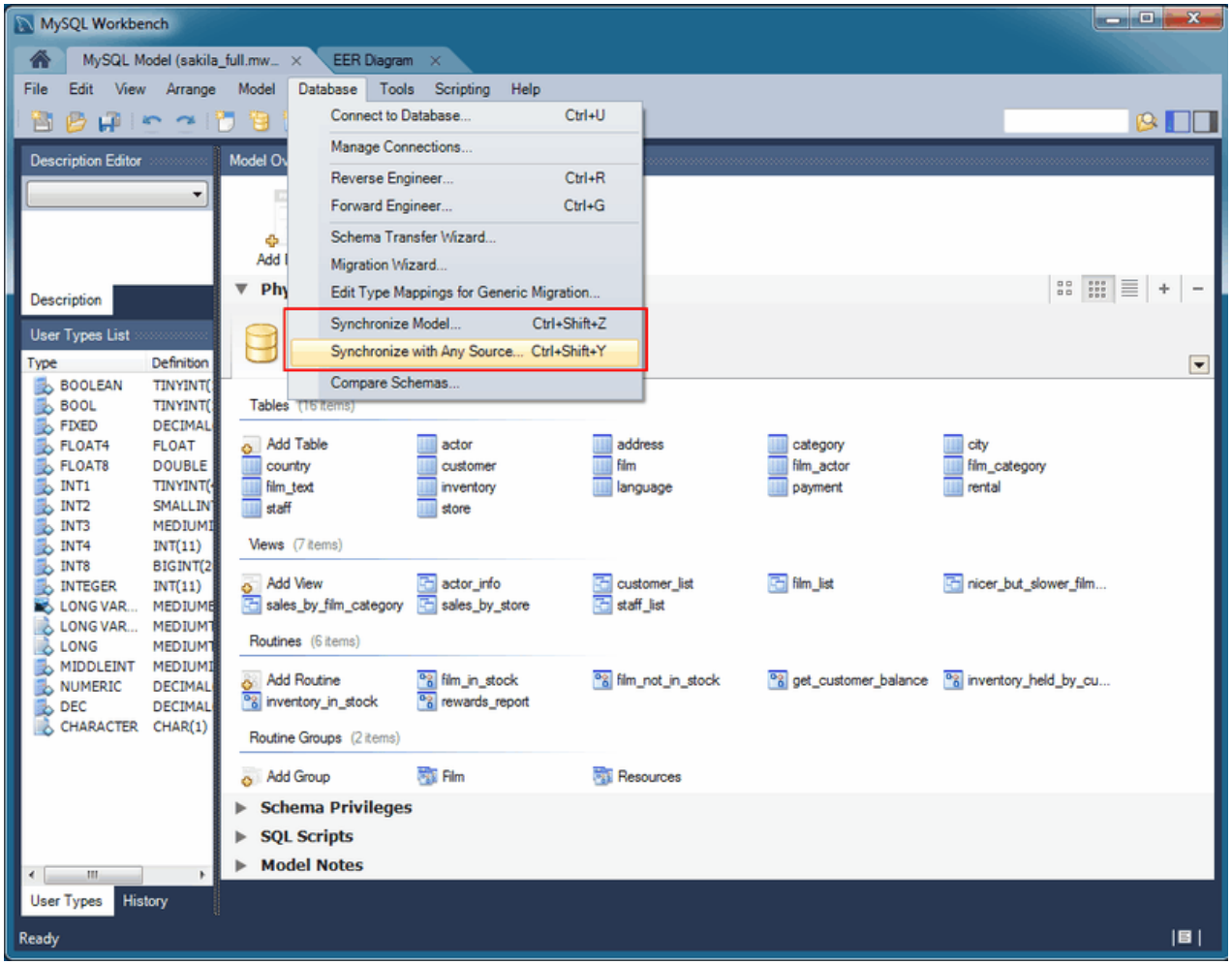
Synchronize data between models, databases, and SQL files. These three types can be the target (destination), source, or both. You can also select/deselect individual objects and modify their direction during the synchronization. For example, synchronize tables from a model to your database, other tables from your database to your model, and skip a few tables, all during the same synchronization process.

Note

Be aware that backward incompatible MySQL syntax changes are introduced over time, so for this reason it is important to set the **Default Target MySQL Version** modeling preference according to your needs. For example, exporting results from a MySQL 5.7 target might yield invalid syntax when executed against MySQL 5.1. See also Section 3.2.4, “Modeling Preferences”.

To start, select Synchronize With Any Source from the Database navigation menu. Alternatively, select **Synchronize Model** to open the same wizard that defaults to a model. A Model or EER diagram must be selected for these synchronization options to be present under the Database navigation menu.

Figure 9.50 Start the Synchronization Wizard



Caution

Because MySQL databases correspond to directories within the data directory, you must consider case sensitivity for database, table, and trigger names, which follow the case sensitivity rules of the underlying file system for your operating system. Synchronizing models with objects that differ in case may lead to MySQL Workbench producing a `DROP` statement for that object, before recreating it as lowercase. For more information, see Identifier Case Sensitivity

Workarounds include using a consistent convention, where the most portable code uses lower case database and table names. Or a temporary workaround is to delete the `DROP SCHEMA IF EXISTS` line from the generated query.

MySQL Workbench enables control over objects to synchronize, and the direction of synchronization for each object. Synchronization options include:

- Specify all or specific tables and objects to synchronize
- Synchronize both the model and live database, or only update one or the other (unidirectional or bidirectional)
- Optionally update from or to an SQL script file

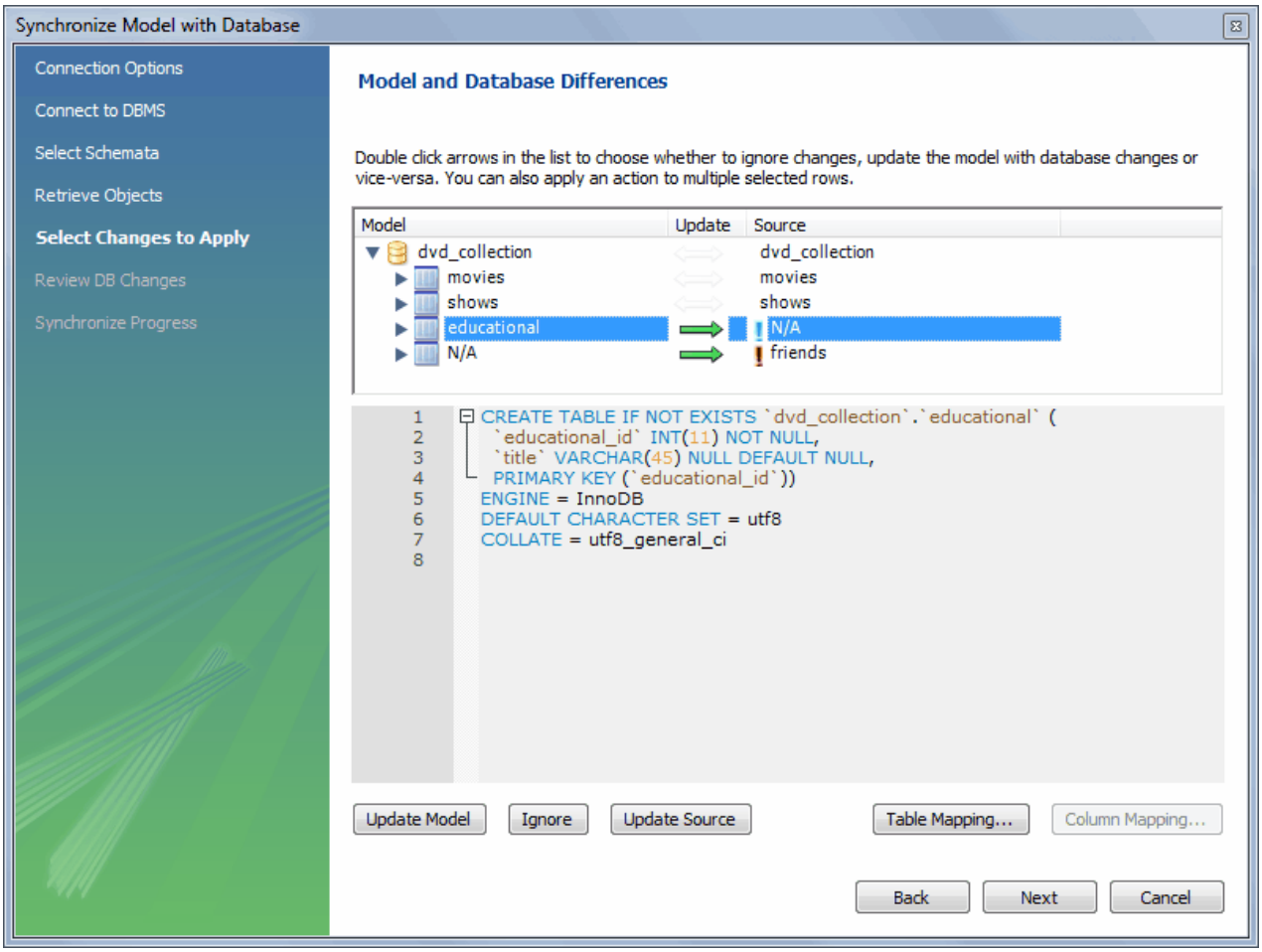
- Instead of executing the synchronization, you may generate an **ALTER Script File** to later perform the appropriate updates
- Fine-tune how the synchronization will be performed by choosing the direction of each individual object, or configuring particular objects to be ignored

There are two similar database synchronization wizards available from the Database menu. The simpler **Synchronize Model** wizard, and the more flexible **Synchronize with Any Source** wizard. The descriptions below apply to both, unless explicitly told otherwise.

Synchronize Model (with database)

To start the wizard, open a model and select Database, Synchronize Model from the main menu. Follow the steps until you reach the **Select Changes to Apply** step:

Figure 9.51 Model and Database Differences

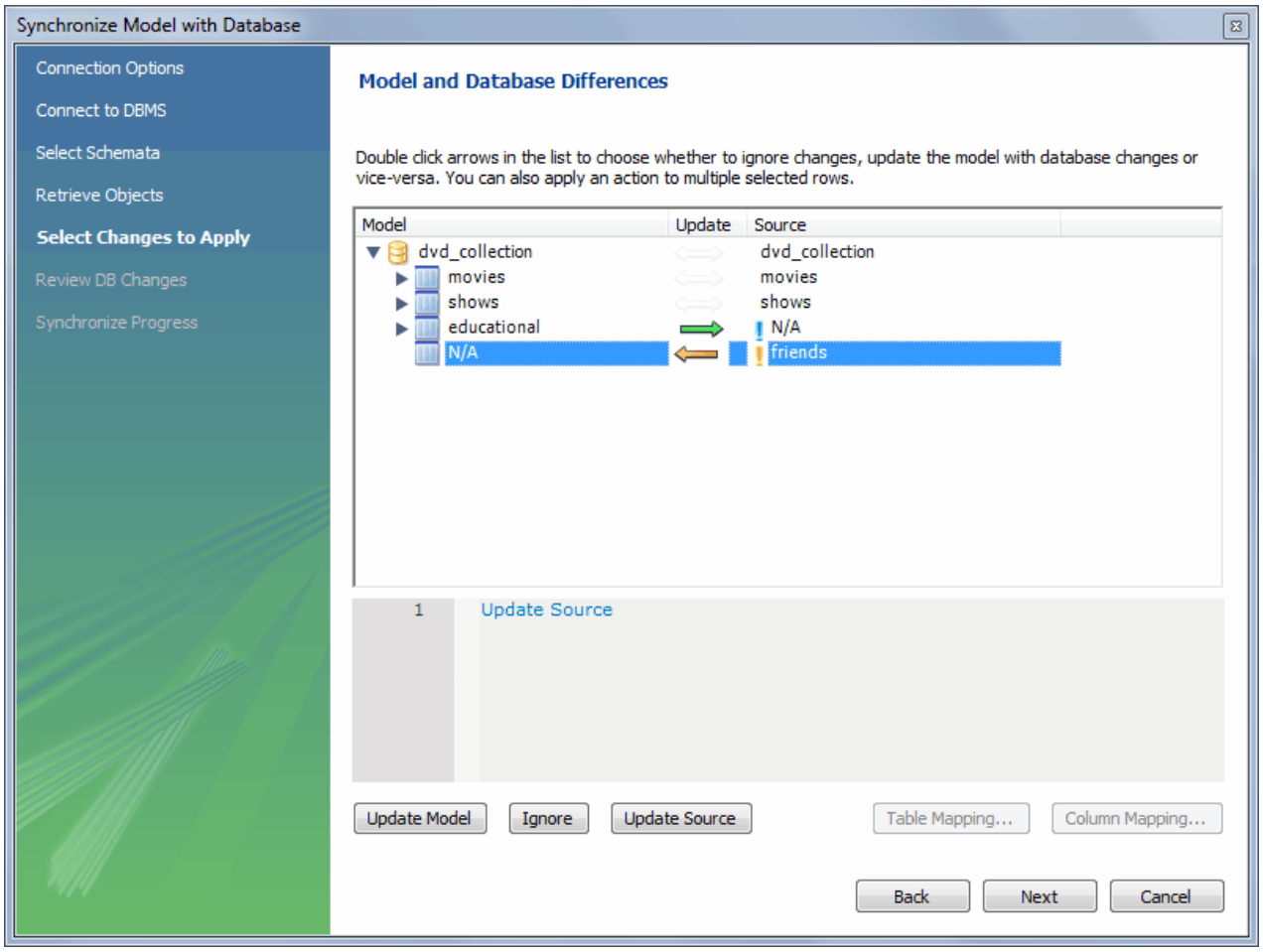


In the preceding example, the live database and model both have `movies` `shows` tables. In the MySQL Workbench, an additional table, `educational`, has been created in the model, but it lacks an equivalent in the live database. Further, `friends` exists in the live database, but it is not in the model. By default, the actions will synchronize the database with the model, so in this example the `educational` table will be added to the source, and the `friends` table will be removed from the source.

As described in the GUI, double-clicking the arrows will alternate between the Update Model, Ignore, and Update Source actions. You may also select a row and click one of the three action buttons. Also note that clicking on a row will reveal the associated SQL statement, as shown in the screenshot above.

The next example shows how the direction of synchronization can be changed.

Figure 9.52 Controlling Synchronization Direction



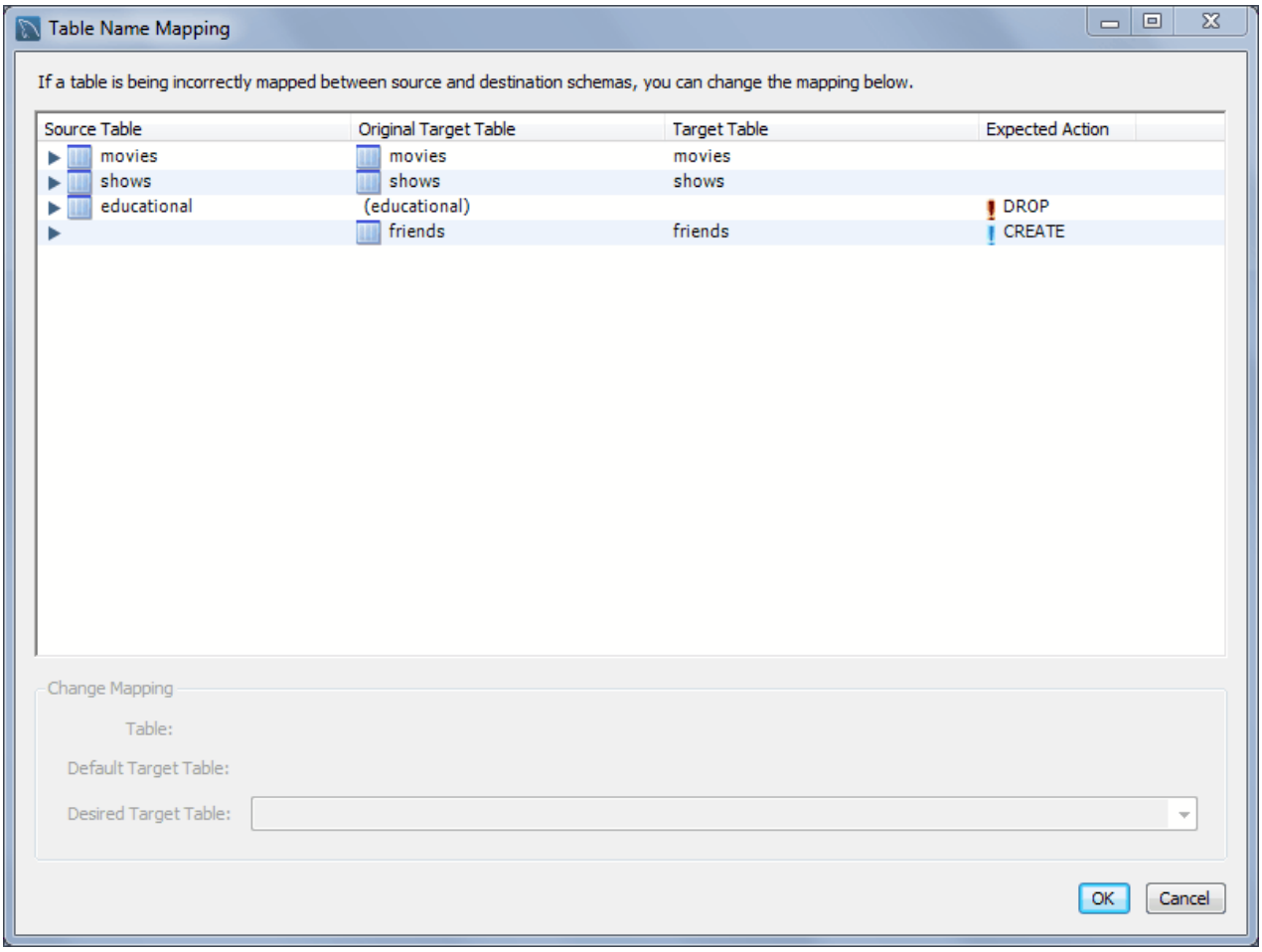
In this case, the synchronization direction has been changed so that rather than the default action of `friends` being dropped from the live database, it will be incorporated into the MySQL Workbench model. As before, `educational` table will be added to the live (source) database.

The three actions available actions are:

- Update Model: Causes the selected changes to be applied to the model, from the live database.
- Ignore: Causes the changes to be ignored. No synchronization will take place for those changes. This is designated with a double arrow that is crossed out.
- Update Source: Causes the changes to be applied only to the live database.

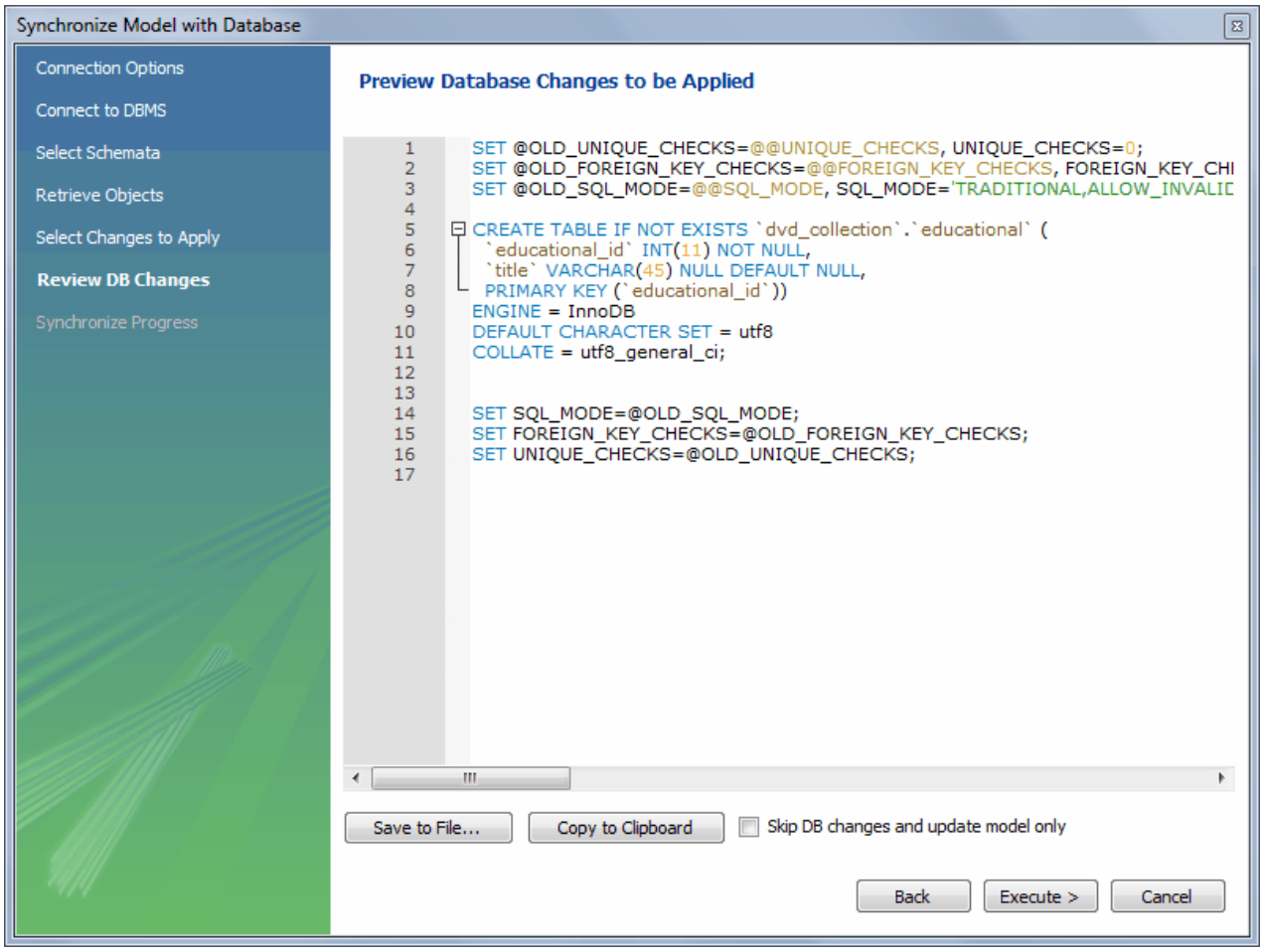
Clicking Table Mapping offers additional mapping options:

Figure 9.53 Table Mapping



Pressing Next will reveal the SQL statement to perform the configured model and live database (source) synchronization:

Figure 9.54 Previewing The Synchronization SQL Statement

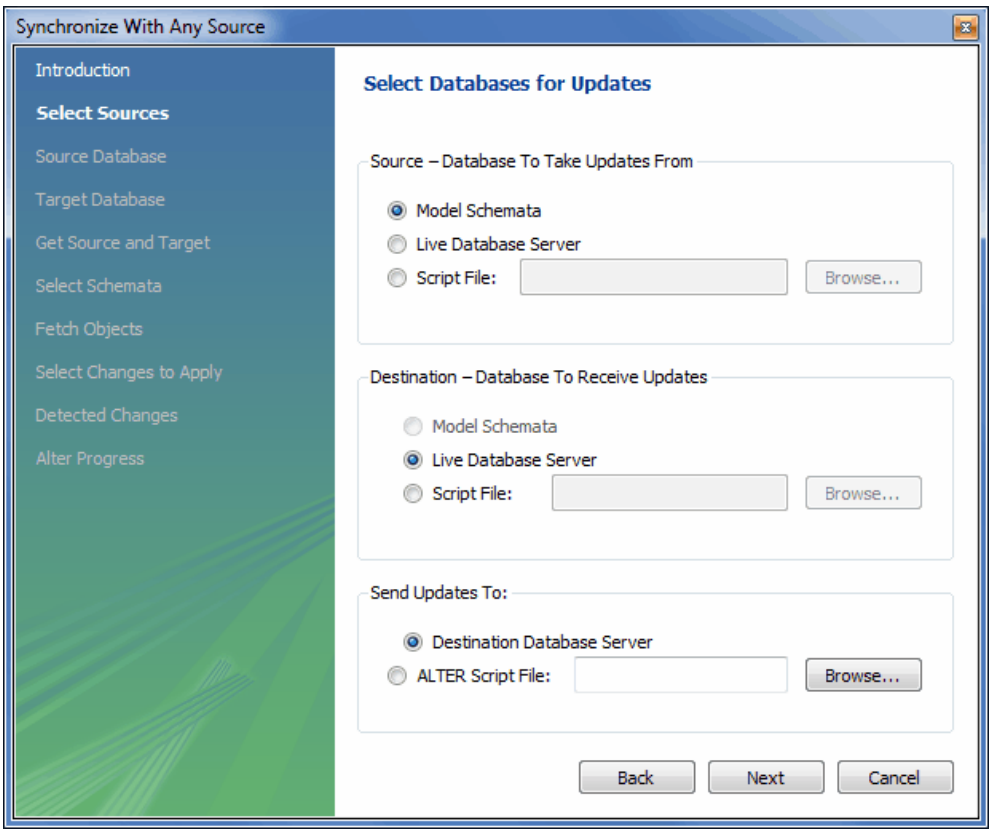


You may now save the SQL statement to a file or the clipboard, or execute the SQL statement. If you choose to execute the change in MySQL Workbench, then you may optionally choose to skip "DB changes" so that only your model is altered.

Synchronize With Any Source

To start the wizard, open a model and select Database, Synchronize With Any Source from the main menu. The steps are similar to the Synchronize Model wizard, but with additional options to create and/or use SQL script files. See the **Select Sources** page:

Figure 9.55 Synchronize With Any Source: Select Sources



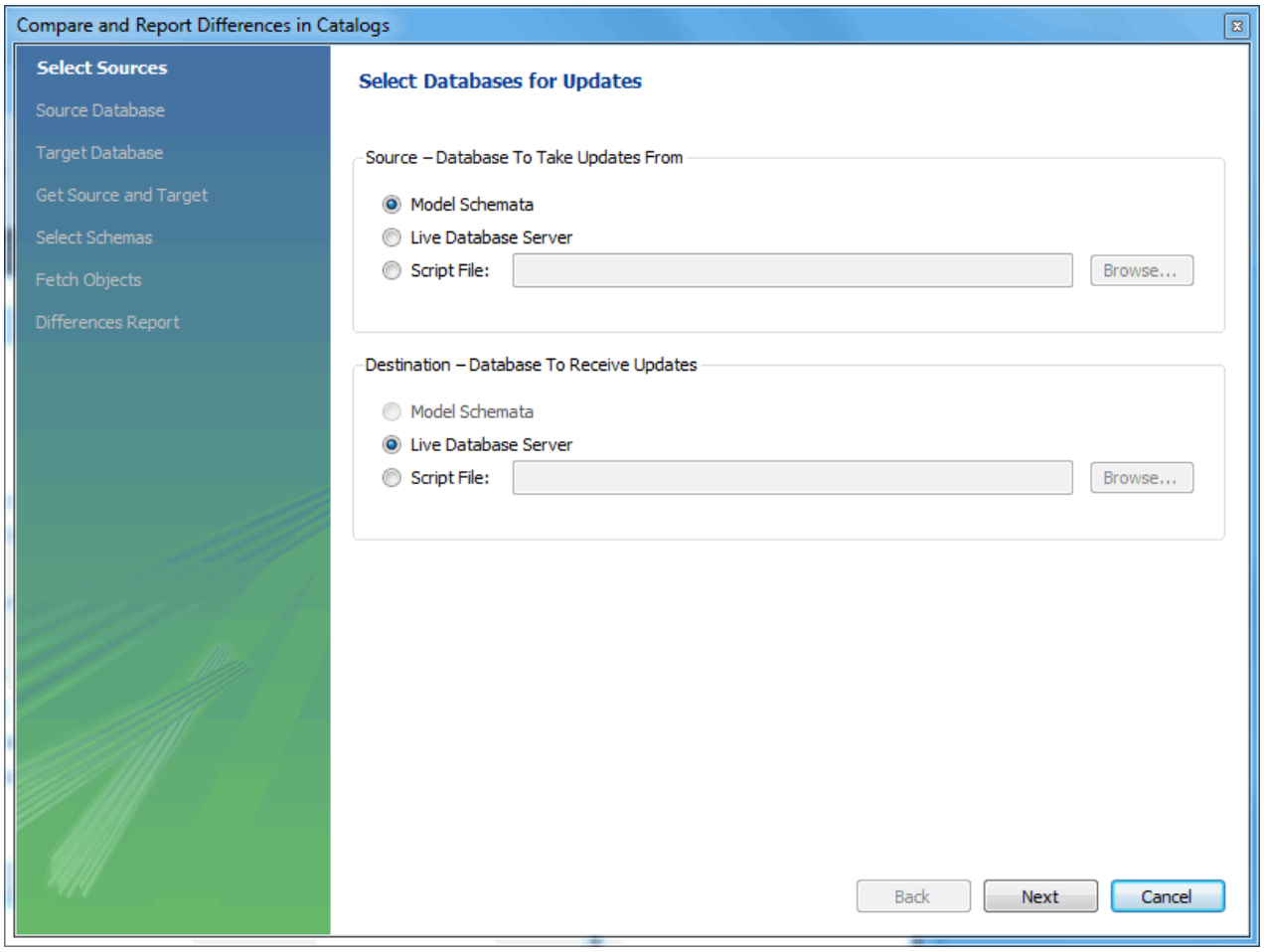
Notice how the source and destination types can be altered. The steps that follow depend on these source and destination types, and the **Synchronize Model** describes the basic functionality of this wizard.

9.5.2 Compare and Report Differences in Catalogs

This facility enables you to create a report detailing the differences between your MySQL Workbench model, and a live database or script. Choose Database, Compare Schemas from the main menu to run the **Compare and Report Differences in Catalogs** wizard.

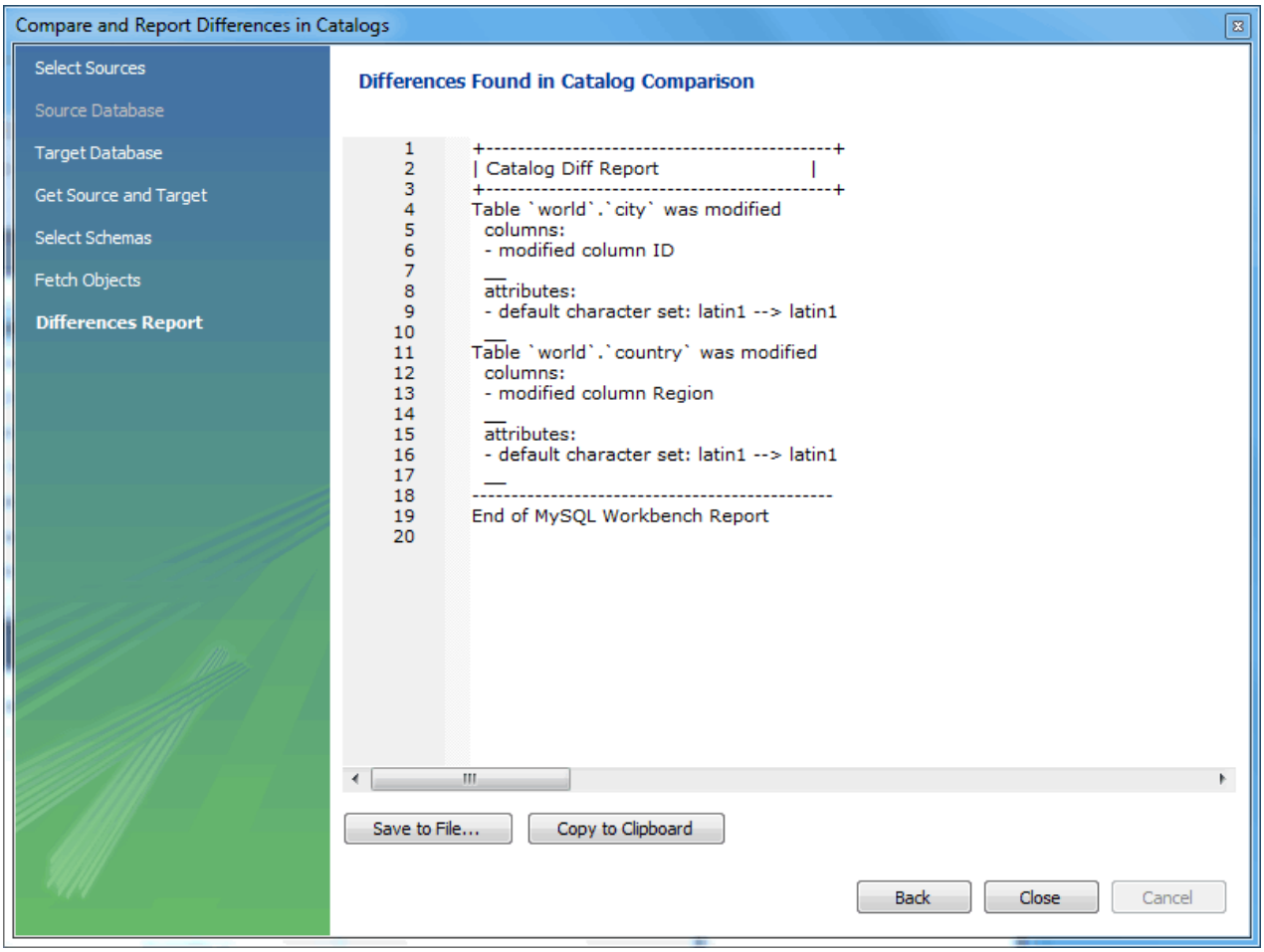
The first step in the wizard is to specify which catalogs to compare. For example, you may wish to compare your live database against your current MySQL Workbench model.

Figure 9.56 Catalog Sources Selection



You then proceed through the wizard, providing connection information if accessing a live database. The wizard then produces a catalog diff report showing the differences between the compared catalogs.

Figure 9.57 Catalog Differences Report

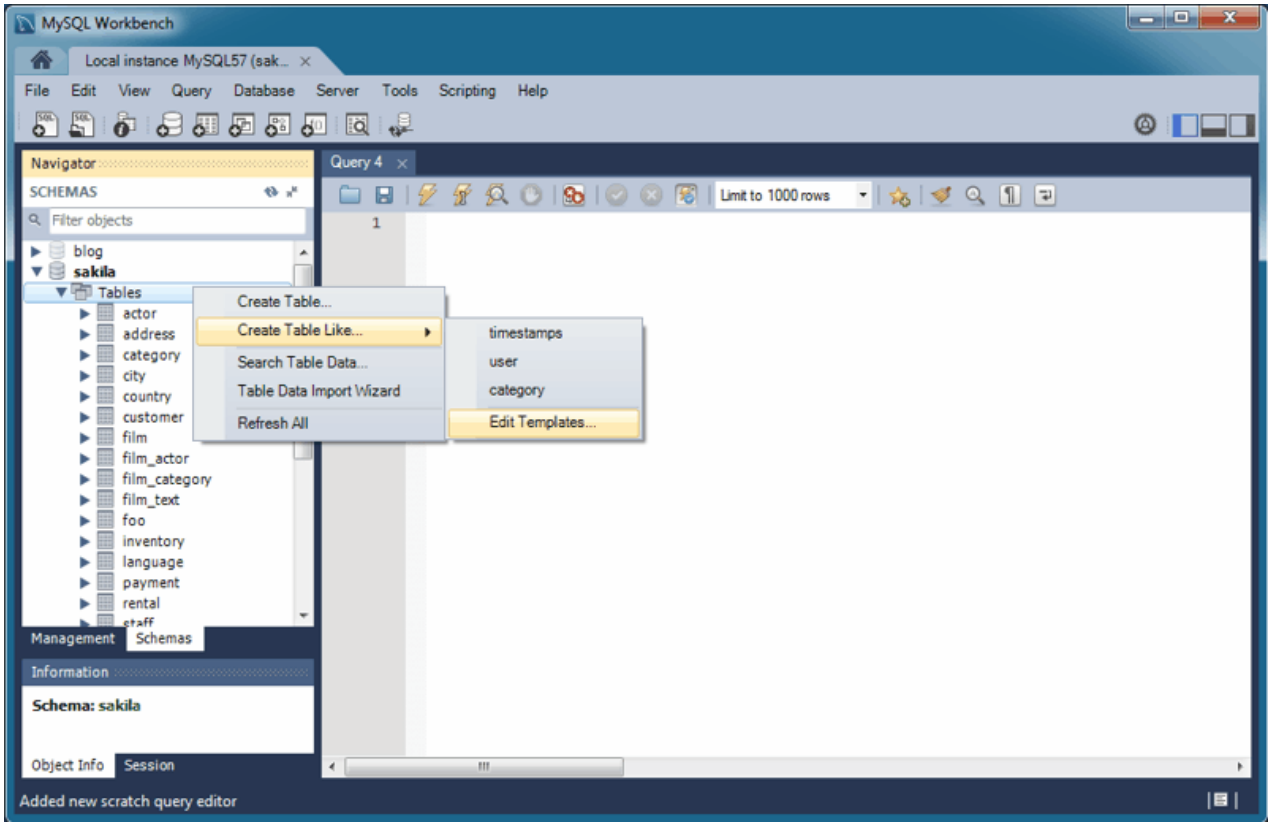


9.6 Table Templates

Define table templates with commonly used columns and settings to create new tables from either a live connection or while creating an EER model.

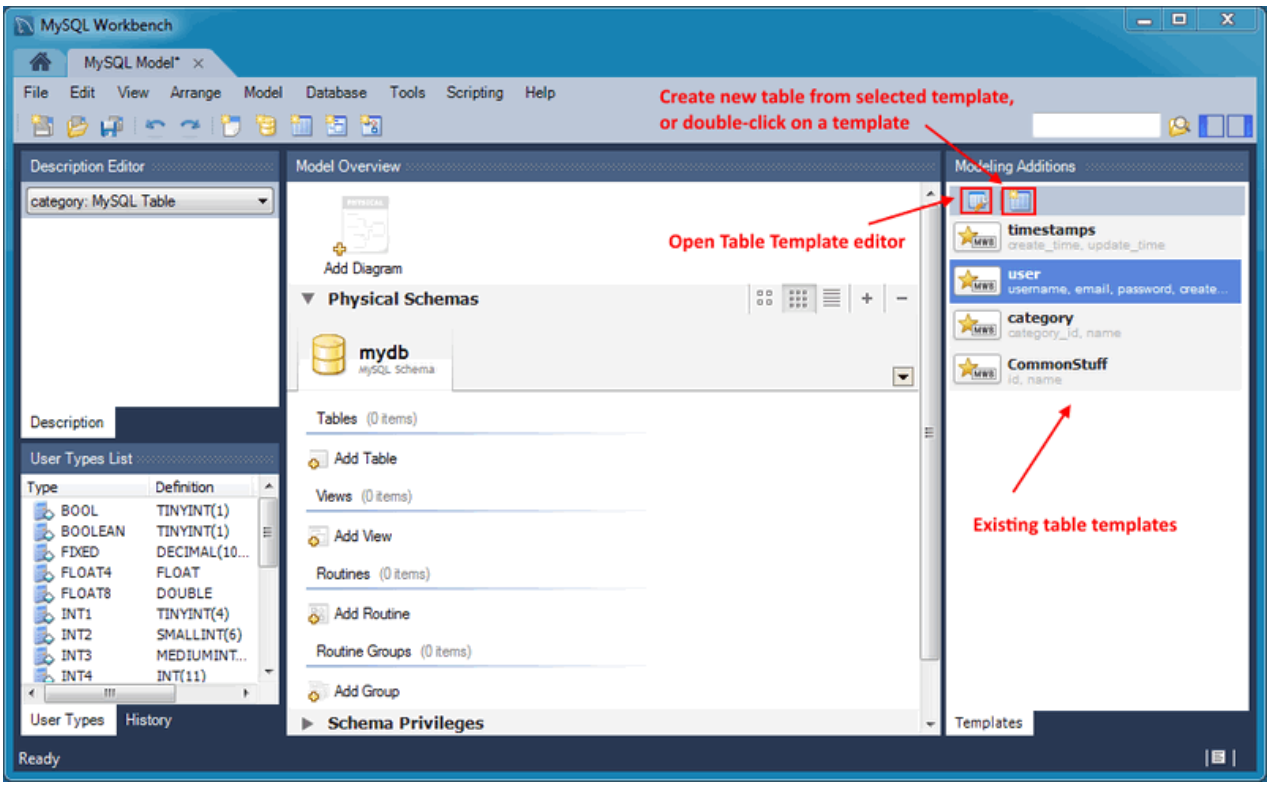
From the SQL editor, select Create Table Like from the **Tables** context menu.

Figure 9.58 New Table Template: SQL Editor



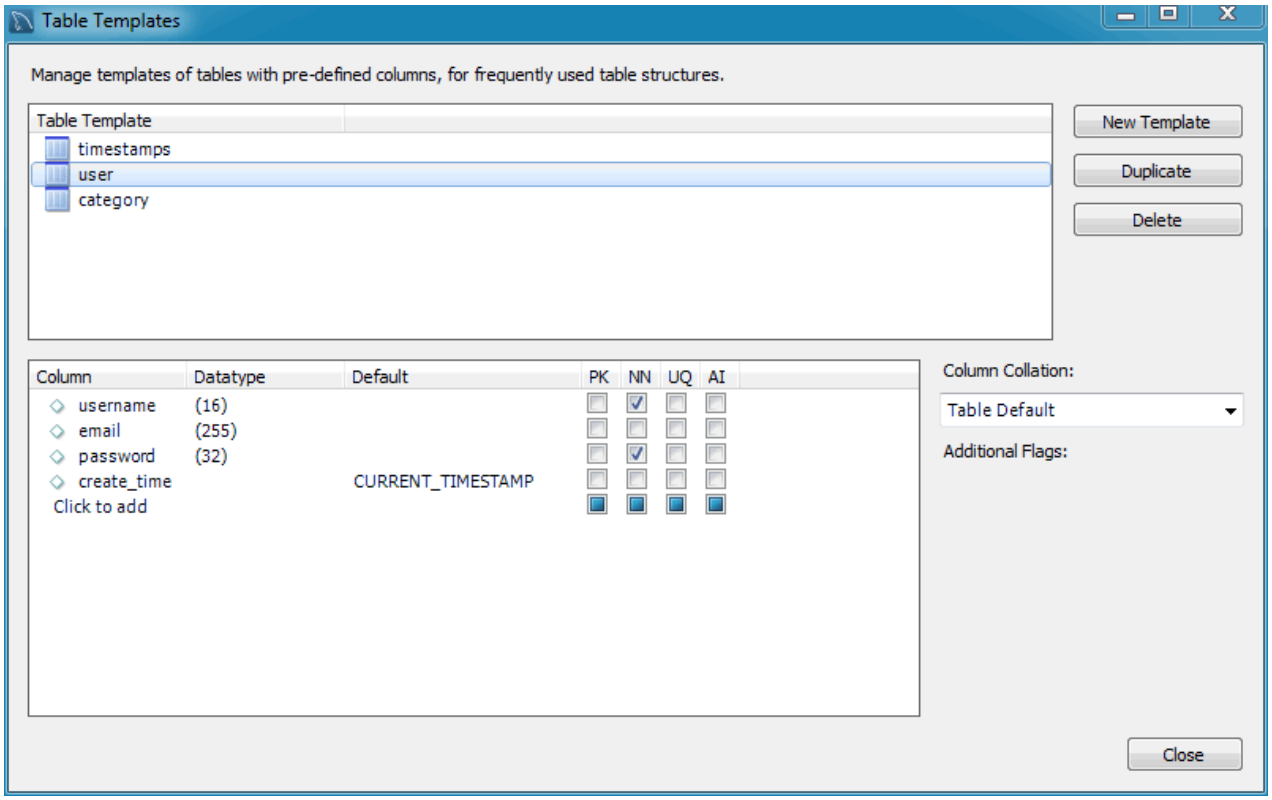
Or while modeling, click the "Open the table template editor" icon on the right sidebar under **Modeling Additions**.

Figure 9.59 New Table Template: Modeling



After opening the **Table Templates** manager, make the desired adjustments and click Apply to commit the changes.

Figure 9.60 Table Templates Manager



To open an existing template from the SQL editor, hover over the Create Table Like context menu and select the desired table template. For modeling, double-click on a template in the right modeling sidebar.

9.7 Customizing DBDoc Model Reporting Templates

This section provides an overview of creating and modifying DBDoc Model Reporting templates, as used by MySQL Workbench.

The MySQL Workbench DBDoc Model Reporting system is based on the Google Template System. This discussion does not attempt to explain the Google Template System in detail. For a useful overview of how the Google Template System works, see the Google document, How To Use the Google Template System.

The templates employed by the DBDoc Model Reporting system are text files that contain *Markers*. These text files are processed by the template system built into MySQL Workbench, and the markers replaced by actual data. The output files are then generated. It is these output files, typically HTML or text, that are then viewed by the user.

Markers can be of six types:

- Template Include
- Comment
- Set delimiter
- Pragma

- Variable
- Section start and Section end

The last two are the most commonly used in MySQL Workbench templates and these important markers are briefly described in the following sections.

- **Variables**

  Variable usage in the templates is straightforward. Variables denoted by markers in the template file are replaced by their corresponding data prior to the generated output file. The mapping between variables and their corresponding data is stored by MySQL Workbench in a *data dictionary*. In the data dictionary, the variable name is the *key* and the variable's corresponding data is the *value*. MySQL Workbench builds the data dictionaries and fills it with the data contained in the processed model.

  By way of example, the following code snippet shows part of a template file:

```
Total number of Schemata: {{SCHEMA_COUNT}}
```

  In the generated output file, the variable `{{SCHEMA_COUNT}}` is replaced by the number of schemata in the model:

```
Total number of Schemata: 2
```

  A variable can appear multiple times in the template file.

- **Sections**

  Sections are used to perform iteration in the templates. When MySQL Workbench exchanges the variables in a section for data, it does so iteratively, using all data in the data dictionary in which the variable is defined. MySQL Workbench builds the data dictionaries according to the model currently being processed.

  Consider the following code snippet:

```
{{#SCHEMATA}}
Schema: {{SCHEMA_NAME}}
{{/SCHEMATA}}
```

  In the preceding snippet, the section start and end are indicated by the `{{#SCHEMATA}}` and `{{/SCHEMATA}}` markers. When MySQL Workbench processes the template, it notes the section and iterates it until the variable data for `{{SCHEMA_NAME}}` in the corresponding data dictionary is exhausted. For example, if the model being processed contains two schemata, the output for the section might resemble the following:

```
Schema: Airlines
Schema: Airports
```

Data Dictionaries

It is important to understand the relationship between sections and data dictionaries in more detail. In a data dictionary the *key* for a variable is the variable name, a marker. The variable *value* is the variable's data. The entry for a section in a data dictionary is different. For a section entry in a data dictionary, the key is the section name, the marker. However, the value associated with the key is a list of data dictionaries. In MySQL Workbench each section is usually associated with a data dictionary. You can think of a section as *activating* its associated dictionary (or dictionaries).

When a template is processed, data dictionaries are loaded in a hierarchical pattern, forming a tree of data dictionaries. This is illustrated by the following table.

Table 9.1 Data Dictionaries Tree

Data Dictionary	Loads Data Dictionary
MAIN	SCHEMATA
SCHEMATA	TABLES, COLUMNS (Detailed is true), FOREIGN_KEYS (Detailed is true), INDICES (Detailed is true)
TABLES	REL_LISTING, INDICES_LISTING, COLUMNS_LISTING, TABLE_COMMENT_LISTING, DDL_LISTING
COLUMNS_LISTING	COLUMNS (Detailed is false)
REL_LISTING	REL (Detailed is false)
INDICES_LISTING	INDICES (Detailed is false)

The root of the tree is the *main* dictionary. Additional dictionaries are loaded from the root to form the dictionary tree.

Note

If a template has no sections, any variables used in the template are looked up in the main dictionary. If a variable is not found in the main dictionary (which can be thought of as associated with the default, or main, section), no data is generated in the output file for that marker.

Evaluation of variables

The tree structure of the data dictionaries is important with respect to variable evaluation. As variables are defined in data dictionaries, their associated values have meaning only when that particular data dictionary is active, and that means when the section associated with that data dictionary is active. When a variable lookup occurs, the system checks the data dictionary associated with the current section. If the variable value can be found there, the replacement is made. However, if the variable's value is not found in the current data dictionary, the parent data dictionary is checked for the variable's value, and so on up the tree until the main data dictionary, or root, is reached.

Suppose that we want to display the names of all columns in a model. Consider the following template as an attempt to achieve this:

```
Report
------
Column Name: {{COLUMN_NAME}}
```

This template produces no output, even for a model that contains one or more columns. In this example, the only data dictionary active is the main dictionary. However, `COLUMN_NAME` is stored in the `COLUMNS` data dictionary, which is associated with the `COLUMNS` section.

With this knowledge, the template can be improved as follows:

```
Report
------
{{#COLUMNS}}
Column Name: {{COLUMN_NAME}}
{{/COLUMNS}}
```

This still does not produce output. To see why, see Table 9.1, “Data Dictionaries Tree”. The COLUMNS data dictionary has the parent dictionary COLUMNS_LISTING. COLUMNS_LISTING has the parent TABLES, which has the parent SCHEMATA, whose parent is the main dictionary. Remember that for a dictionary to be involved in variable lookup, its associated section must currently be active.

To achieve the desired output, the template must be something like the following:

```
Report
------

{{#SCHEMATA}}
{{#TABLES}}
{{#COLUMNS_LISTING}}
{{#COLUMNS}}
Column Name: {{COLUMN_NAME}}
{{/COLUMNS}}
{{/COLUMNS_LISTING}}
{{/TABLES}}
{{/SCHEMATA}}
```

The following template is the same, but with explanatory comments added:

```
Report
------

{{! Main dictionary active}}
{{#SCHEMATA}}  {{! SCHEMATA dictionary active}}
{{#TABLES}}  {{! TABLES dictionary active}}
{{#COLUMNS_LISTING}} {{! COLUMNS_LISTING dictionary active}}
{{#COLUMNS}}  {{! COLUMNS dictionary active}}
Column Name: {{COLUMN_NAME}} {{! COLUMN_NAME variable is looked-up,
and found, in COLUMNS data dictionary}}
{{/COLUMNS}}
{{/COLUMNS_LISTING}}
{{/TABLES}}
{{/SCHEMATA}}
```

Imagine now that for each column name displayed you also wanted to display its corresponding schema name, the template would look like this:

```
Report
------

{{#SCHEMATA}}
{{#TABLES}}
{{#COLUMNS_LISTING}}
{{#COLUMNS}}
Schema Name: {{SCHEMA_NAME}} Column Name: {{COLUMN_NAME}}
{{/COLUMNS}}
{{/COLUMNS_LISTING}}
{{/TABLES}}
{{/SCHEMATA}}
```

When variable lookup is performed for SCHEMA_NAME, the COLUMNS dictionary is checked. As the variable is not found there the parent dictionary will be checked, COLUMNS_LISTING, and so on, until the variable is eventually found where it is held, in the SCHEMATA dictionary.

If there are multiple schemata in the model, the outer section is iterated over a matching number of times, and SCHEMA_NAME accordingly has the correct value on each iteration.

It's important to always consider which dictionary must be active (and which parents) for a variable to be evaluated correctly. The following section has a table that helps you identify section requirements.

9.7.1 Supported Template Markers

The following table shows the supported markers. These markers can be used in any template, including custom templates.

Using the table

The table shows which variables are defined in which sections. The variable should be used in its correct section or its value will not be displayed. If a variable `type` is a variable, then the table describes its data dictionary, and a parent dictionary if `type` is a section. Also remember that the data dictionaries used to perform variable lookups form a hierarchical tree, so it is possible to use a variable in a child section that is defined in a parent section.

Table 9.2 Supported Template Markers

Marker text	Type	Data Dictionary or Parent Dictionary	Corresponding data
TITLE	Variable	MAIN	Title of the report
GENERATED	Variable	MAIN	Date and time when the report was generated
STYLE_NAME	Variable	MAIN	The name of the style selected in MySQL Workbench, this is typically used to load the corresponding CSS file, depending on the name of the style selected in MySQL Workbench
SCHEMA_COUNT	Variable	MAIN	The number of schemata in the model
PROJECT_TITLE	Variable	MAIN	Project title as set for the model in Document Properties
PROJECT_NAME	Variable	MAIN	Project name as set for the model in Document Properties
PROJECT_AUTHOR	Variable	MAIN	Project author as set for the model in Document Properties
PROJECT_VERSION	Variable	MAIN	Project version as set for the model in Document Properties
PROJECT_DESCRIPTION	Variable	MAIN	Project description as set for the model in Document Properties
PROJECT_CREATED	Variable	MAIN	Automatically set for the model project, but as displayed in Document Properties
PROJECT_CHANGED	Variable	MAIN	Automatically set for the model project, but as displayed in Document Properties
TOTAL_TABLE_COUNT	Variable	MAIN	The number of tables in all schemata in the model

Marker text	Type	Data Dictionary or Parent Dictionary	Corresponding data
TOTAL_COLUMN_COUNT	Variable	MAIN	The number of columns in all tables in all schemata in the model
TOTAL_INDEX_COUNT	Variable	MAIN	The number of indexes in the model
TOTAL_FK_COUNT	Variable	MAIN	The number of foreign keys in the model
SCHEMATA	Section	MAIN	Used to mark the start and end of a SCHEMATA section; the SCHEMATA data dictionary becomes active in this section
SCHEMA_NAME	Variable	SCHEMATA	The schema name
SCHEMA_ID	Variable	SCHEMATA	The schema ID
TABLE_COUNT	Variable	SCHEMATA	The number of tables in the current schema
COLUMN_COUNT	Variable	SCHEMATA	The number of columns in the current schema
INDICES_COUNT	Variable	SCHEMATA	The number of indexes in the current schema
FOREIGN_KEYS_COUNT	Variable	SCHEMATA	The number of foreign keys in the current schema
TABLES	Section	SCHEMATA	Marks the start and end of a TABLES section; the TABLES data dictionary becomes active in this section
TABLE_NAME	Variable	TABLES	The table name
TABLE_ID	Variable	TABLES	The table ID
COLUMNS_LISTING	Section	TABLES	Marks the start and end of a COLUMNS_LISTING section; the COLUMNS_LISTING data dictionary becomes active in this section
COLUMNS	Section	COLUMNS_LISTING	Marks the start and end of a COLUMNS section; the COLUMNS data dictionary becomes active in this section
COLUMN_KEY	Variable	COLUMNS	Whether the column is a primary key
COLUMN_NAME	Variable	COLUMNS	The column name
COLUMN_DATATYPE	Variable	COLUMNS	The column data type
COLUMN_NOTNULL	Variable	COLUMNS	Whether the column permits `NULL` values
COLUMN_DEFAULTVALUE	Variable	COLUMNS	The column default value

Marker text	Type	Data Dictionary or Parent Dictionary	Corresponding data
COLUMN_COMMENT	Variable	COLUMNS	The column comment
COLUMN_ID	Variable	COLUMNS	The column ID
COLUMN_KEY_PART	Variable	COLUMNS (if detailed)	The column key type
COLUMN_NULLABLE	Variable	COLUMNS (if detailed)	Can the column contain `NULL` values
COLUMN_AUTO_INC	Variable	COLUMNS (if detailed)	Does the column auto-increment
COLUMN_CHARSET	Variable	COLUMNS (if detailed)	The column character set
COLUMN_COLLATION	Variable	COLUMNS (if detailed)	The column collation
COLUMN_IS_USERTYPE	Variable	COLUMNS (if detailed)	Whether the column is a user type
INDICES_LISTING	Section	TABLES	Marks the start and end of an INDICES_LISTING section; the INDICES_LISTING data dictionary becomes active in this section
INDICES	Section	INDICES_LISTING	Marks the start and end of an INDICES section; the INDICES data dictionary becomes active in this section
INDEX_NAME	Variable	INDICES	The index name
INDEX_PRIMARY	Variable	INDICES	Whether this is a primary key
INDEX_UNIQUE	Variable	INDICES	Whether this is a unique index
INDEX_TYPE	Variable	INDICES	The index type; for example, PRIMARY
INDEX_KIND	Variable	INDICES	The index kind
INDEX_COMMENT	Variable	INDICES	The index comment
INDEX_ID	Variable	INDICES	The index ID
INDEX_COLUMNS	Section	INDICES	Marks the start and end of an INDEX_COLUMNS section; the INDEX_COLUMNS data dictionary becomes active in this section
INDEX_COLUMN_NAME	Variable	INDEX_COLUMNS	The index column name
INDEX_COLUMN_ORDER	Variable	INDEX_COLUMNS	The index column order; for example, ascending, descending
INDEX_COLUMN_COMMENT	Variable	INDEX_COLUMNS	The index comment
INDEX_KEY_BLOCK_SIZE	Variable	INDEX_COLUMNS (if detailed)	The index key-block size
REL_LISTING	Section	TABLES	Marks the start and end of a REL_LISTING section; the

Marker text	Type	Data Dictionary or Parent Dictionary	Corresponding data
			REL_LISTING data dictionary becomes active in this section
REL	Section	REL_LISTING	Marks the start and end of a REL section; the REL data dictionary becomes active in this section
REL_NAME	Variable	REL, FOREIGN_KEYS	The relationship name
REL_TYPE	Variable	REL, FOREIGN_KEYS	The relationship type
REL_PARENTTABLE	Variable	REL, FOREIGN_KEYS	The relationship parent table
REL_CHILDTABLE	Variable	REL, FOREIGN_KEYS	The relationship child table
REL_CARD	Variable	REL, FOREIGN_KEYS	The relationship cardinality
FOREIGN_KEY_ID	Variable	REL	Foreign key ID
FOREIGN_KEYS	Section	SCHEMATA	Marks the start and end of a FOREIGN_KEYS section; the FOREIGN_KEYS data dictionary becomes active in this section
FK_DELETE_RULE	Variable	FOREIGN_KEYS	The foreign key delete rule
FK_UPDATE_RULE	Variable	FOREIGN_KEYS	The foreign key update rule
FK_MANDATORY	Variable	FOREIGN_KEYS	Whether the foreign key is mandatory
TABLE_COMMENT_LISTING	Section	TABLES	Marks the start and end of a TABLE_COMMENT_LISTING section; the TABLE_COMMENT_LISTING data dictionary becomes active in this section
TABLE_COMMENT	Variable	TABLE_COMMENT_LISTING	The table comment
DDL_LISTING	Section	TABLES	Marks the start and end of a DDL_LISTING section; the DDL_LISTING data dictionary becomes active in this section
DDL_SCRIPT	Variable	DDL_LISTING	Display the DDL script of the currently active entity; for example, SCHEMATA, TABLES

9.7.2 Creating a Custom Template

In the simplest case, a template consists of two files: a template file, which has a `.tpl` extension, and a special file `info.xml`. The `info.xml` file has important metadata about the template. A third file is optional, which is the preview image file. This preview file provides a thumbnail image illustrating the appearance of the generated report.

One of the easiest ways to create a custom template is to make a copy of any existing template.

For example, the following procedure describes how to make a custom template based on the `Text Basic` template.

1. Navigate to the folder where the templates are stored. Assuming that MySQL Workbench has been installed into the default location on Windows, this would be `C:\Program Files\MySQL\MySQL Workbench 5.0 SE\modules\data\wb_model_reporting`.

2. Copy the `Text_Basic.tpl` folder. The copy can be given any suitable name; for example, `Custom_Basic.tpl`.

3. Edit the `info.xml` file to reflect your custom template. The unedited file in this case is shown here:

```
<?xml version="1.0"?>
<data>
  <value type="object" struct-name="workbench.model.reporting.TemplateInfo"
  id="{BD6879ED-814C-4CA3-A869-9864F83B88DF}" struct-checksum="0xb46b524d">
    <value type="string" key="description">
      A basic TEXT report listing schemata and objects.
    </value>
    <value type="string" key="name">HTML Basic Frame Report</value>
    <value type="list" content-type="object"
    content-struct-name="workbench.model.reporting.TemplateStyleInfo"
    key="styles">
      <value type="object" struct-name="workbench.model.reporting.TemplateStyleInfo"
      id="{7550655C-CD4B-4EB1-8FAB-AAEE49B2261E}" struct-checksum="0xab08451b">
        <value type="string" key="description">
          Designed to be viewed with a fixed sized font.
        </value>
        <value type="string" key="name">Fixed Size Font</value>
        <value type="string" key="previewImageFileName">
          preview_basic.png
        </value>
        <value type="string" key="styleTagValue">fixed</value>
      </value>
    </value>
    <value type="string" key="mainFileName">report.txt</value>
  </value>
</data>
```

   The file defines wwo objects: the `TemplateInfo` object and the `TemplateStyleInfo` object. These objects contain information about the template that will be displayed in the DBDoc Model Reporting wizard main page.

4. Change the object GUIDs that are used in the file. In this example, there are two that need replacing:

```
id="{BD6879ED-814C-4CA3-A869-9864F83B88DF}"
...
id="{7550655C-CD4B-4EB1-8FAB-AAEE49B2261E}"
```

   Generate two new GUIDS. This is done using a suitable command-line tool, and there are also free online tools that generate GUIDs. MySQL's `UUID()` function also generates GUIDs:

```
mysql> SELECT UUID();
+--------------------------------------+
| UUID()                               |
+--------------------------------------+
| 648f4240-7d7a-11e0-870b-89c43de3bd0a |
+--------------------------------------+
```

   Once you have the new GUID values, edit the `info.xml` file accordingly.

5. Edit the textual information for the `TemplateInfo` and `TemplateStyleInfo` objects to reflect the purpose of the custom template.

6. The modified file will now look something like the following:

```
<?xml version="1.0"?>
<data>
  <value type="object" struct-name="workbench.model.reporting.TemplateInfo"
  id="{cac9ba3f-ee2a-49f0-b5f6-32580fab1640}" struct-checksum="0xb46b524d">
    <value type="string"
    key="description">
      Custom basic TEXT report listing schemata and objects.
    </value>
    <value type="string" key="name">Custom Basic text report</value>
    <value type="list" content-type="object"
    content-struct-name="workbench.model.reporting.TemplateStyleInfo" key="styles">
      <value type="object"
      struct-name="workbench.model.reporting.TemplateStyleInfo"
      id="{39e3b767-a832-4016-8753-b4cb93aa2dd6}" struct-checksum="0xab08451b">
        <value type="string" key="description">
          Designed to be viewed with a fixed sized font.
        </value>
        <value type="string" key="name">Fixed Size Font</value>
        <value type="string" key="previewImageFileName">preview_basic.png</value>
        <value type="string" key="styleTagValue">fixed</value>
      </value>
    </value>
    <value type="string" key="mainFileName">custom_report.txt</value>
  </value>
</data>
```

7. Create the new template file. This too may best be achieved, depending on your requirements, by editing an existing template. In this example the template file `report.txt.tpl` is shown here:

```
+--------------------------------------------+
| MySQL Workbench Report                     |
+--------------------------------------------+

Total number of Schemata: {{SCHEMA_COUNT}}
==============================================
{{#SCHEMATA}}
{{SCHEMA_NR}}. Schema: {{SCHEMA_NAME}}
----------------------------------------------
## Tables ({{TABLE_COUNT}}) ##
{{#TABLES}}{{TABLE_NR_FMT}}. Table: {{TABLE_NAME}}
{{#COLUMNS_LISTING}}## Columns ##
Key  Column  Name  Datatype  Not Null  Default  Comment
{{#COLUMNS}}{{COLUMN_KEY}}{{COLUMN_NAME}}{{COLUMN_DATATYPE}} »
{{COLUMN_NOTNULL}}{{COLUMN_DEFAULTVALUE}}{{COLUMN_COMMENT}}
{{/COLUMNS}}{{/COLUMNS_LISTING}}
{{#INDICES_LISTING}}## Indices ##
Index  Name  Columns  Primary  Unique  Type  Kind  Comment
{{#INDICES}}{{INDEX_NAME}}{{#INDICES_COLUMNS}}{{INDEX_COLUMN_NAME}} »
{{INDEX_COLUMN_ORDER}}{{INDEX_COLUMN_COMMENT}}{{/INDICES_COLUMNS}} »
{{INDEX_PRIMARY}}{{INDEX_UNIQUE}}{{INDEX_TYPE}}{{INDEX_KIND}}{{INDEX_COMMENT}}
{{/INDICES}}{{/INDICES_LISTING}}
{{#REL_LISTING}}## Relationships ##
Relationship  Name  Relationship  Type  Parent Table  Child Table Cardinality
{{#REL}}{{REL_NAME}}{{REL_TYPE}}{{REL_PARENTTABLE}}{{REL_CHILDTABLE}}{{REL_CARD}}
{{/REL}}{{/REL_LISTING}}
----------------------------------------------

{{/TABLES}}
{{/SCHEMATA}}
```

```
==========================================
End of MySQL Workbench Report
```

This template shows details for all schemata in the model.

8. The preceding template file can be edited in any way you like, with new markers being added, and existing markers being removed as required. For the custom template example, you might want to create a much simpler template, such as the one following:

```
+-----------------------------------------+
| MySQL Workbench Custom Report           |
+-----------------------------------------+

Total number of Schemata: {{SCHEMA_COUNT}}
==========================================
{{#SCHEMATA}}
Schema Name: {{SCHEMA_NAME}}
------------------------------------------
## Tables ({{TABLE_COUNT}}) ##

{{#TABLES}}
Table Name: {{TABLE_NAME}}
{{/TABLES}}
{{/SCHEMATA}}

Report Generated On: {{GENERATED}}
==========================================
End of MySQL Workbench Custom Report
```

This simplified report just lists the schemata and the tables in a model. The date and time the report was generated is also displayed as a result of the use of the `{{GENERATED}}` variable.

9. The custom template can then be tested. Start MySQL Workbench, load the model to generate the report for, select the Model, DBDOC - Model Reporting menu item. Then select the new custom template from the list of available templates, select an output directory, and click Finish to generate the report. Finally, navigate to the output directory to view the finished report.

Chapter 10 Database Migration Wizard

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MySQL Workbench provides the ability to migrate ODBC compliant databases to MySQL.

- Convert (migrate) different database types, including MySQL, across servers
- Convert tables and copy data, but will not convert stored procedures, views, or triggers
- Allows customization and editing during the migration process
- Works on Linux, OS X, and Microsoft Windows

This is not an exhaustive list. The following sections discuss these and additional migration capabilities.

Set up may be the most challenging aspect of using the MySQL Workbench Migration Wizard. There is the installation section, which describes setting up ODBC requirements for Linux, OS X, and Microsoft

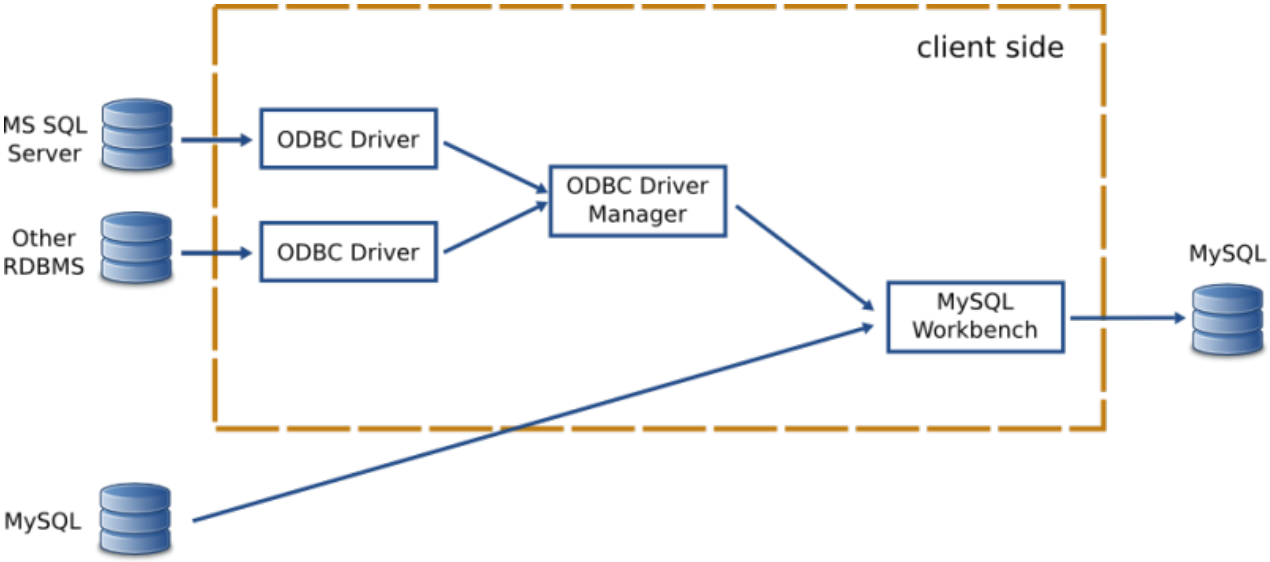
Windows, and the Database Product Specific Notes section that references setup conditions for each RDBMS.

10.1 General installation requirements

The MySQL Workbench Migration Wizard uses ODBC to connect to a source database, except for MySQL. You will need the ODBC driver installed that corresponds to the database you want to migrate from. For example, PostgreSQL can be migrated with the psqlodbc ODBC driver; Microsoft SQL Server can be migrated using the native Microsoft SQL Server driver on Windows or with FreeTDS on Linux and OS X.

The following diagram shows the general components involved in an ODBC connection:

Figure 10.1 MySQL Workbench migration installation diagram



When specifying the source RDBMS, you can either use a data source configured externally, or provide the individual connection parameters to MySQL Workbench. If you already have an ODBC Data Source configured in your system, then you can use that in MySQL Workbench.

Note

The migration process does not support source or target RDBMS connections through SSH.

A workaround is to set up an encrypted tunnel, and then treat the MySQL target as a standard TCP (unencrypted) connection.

10.1.1 ODBC Libraries

Note

This section may be skipped when using a MySQL Workbench binary that is provided by Oracle.

An ODBC Driver Manager library must be present. Both Windows and OS X provide one.

Linux

`iODBC`: MySQL Workbench binaries provided by Oracle already include iODBC and no additional action is required. If you compile it yourself, you must install iODBC or unixODBC. iODBC is recommended. You

can use the iODBC library provided by your distribution by installing the libiodbc2 package on Debian based systems, or libiodbc on RPM based systems.

`pyodbc`: is the Python module used by MySQL Workbench to interface with ODBC, and may be used to migrate ODBC compliant databases such as PostgreSQL and DB2. In Windows and OS X, it is included with Workbench. In Linux, binaries provided by Oracle also include pyodbc.

If you're using a self-compiled binary, make sure you have the latest version, and that it is compiled against the ODBC manager library that you chose, whether it is iODBC or unixODBC. As of version 3.0.6, pyodbc will compile against unixODBC by default. If you are compiling against iODBC then you must perform the following steps:

1. For compiling, make sure you have the iODBC headers installed. For Linux, the name depends on your system's package manager but common names are `libiodbc-devel` (RPM based systems) or `libiodbc2-dev` (Debian based systems). For OS X, the headers come with the system and no additional action is required for this step.

2. In the pyodbc source directory, edit the setup.py file and around line 157, replace the following line: `settings['libraries'].append('odbc')` with `settings['libraries'].append('iodbc')`

3. Execute the following command as the root user: `CFLAGS=`iodbc-config --cflags` LDFLAGS=`iodbc-config --libs` python setup.py install`

10.1.2 ODBC Drivers

For each RDBMS, you need its corresponding ODBC driver, which must also be installed on the same machine that MySQL Workbench is running on. This driver is usually provided by the RDBMS manufacturer, but in some cases they can also be provided by third party vendors or open source projects.

Operating systems usually provide a graphical interface to help set up ODBC drivers and data sources. Use that to install the driver (i.e., make the ODBC Manager "see" a newly installed ODBC driver). You can also use it to create a data source for a specific database instance, to be connected using a previously configured driver. Typically you need to provide a name for the data source (the DSN), in addition to the database server IP, port, username, and sometimes the database the user has access to.

If MySQL Workbench is able to locate an ODBC manager GUI for your system, the Open ODBC Administrator button on the migration wizard's overview page will open it.

- `Linux`: There are a few GUI utilities, some of which are included with unixODBC. Refer to the documentation for your distribution. iODBC provides `iodbcadm-gtk`.
- `OS X`: You can use the ODBC Administrator tool that is separate download from Apple, or an ODBC Management tool from a different vendor. If the tool is installed in the `/Applications/Utilities` folder, you can start it using the Open ODBC Administrator button.
- `Microsoft Windows`: You can use the Data Sources (ODBC) tool under Administrative Tools. If present, the Open ODBC Administrator button will start it.

ODBC Driver architecture

Since the ODBC driver needs to be installed in the client side, you will need an ODBC driver that supports your clients operating system and architecture. For example, if you are running MySQL Workbench from Linux x64, then you need a Linux x64 ODBC driver for your RDBMS. In OS X, MySQL Workbench is built as a 32-bit application, so you need the 32-bit drivers.

10.2 Migration Overview

The Migration Wizard performs the following steps when migrating a database to MySQL:

1. Connects to the source RDBMS and retrieves a list of available databases/schemas.
2. Reverse engineers selected database/schemas into a internal representation specific to the source RDBMS. This step will also perform the renaming of objects/schemas depending on the type of object name mapping method that is chosen.
3. Automatically migrates the source RDBMS objects into MySQL specific objects.
    a. Target schema objects are created.
    b. Target table objects are created.
        i. Columns for each table are copied.
            A. Data types are mapped to MySQL data types.
            B. Default values are mapped to a MySQL supported default value, if possible.
        ii. Indexes are converted.
        iii. Primary Keys are converted.
        iv. Triggers are copied, and commented out if the source is not MySQL.
    c. Foreign Keys for all tables (of all schemas) are converted.
    d. View objects are copied, and commented out if the source is not MySQL.
    e. Stored Procedure and Function objects are copied, and commented out if the source is not MySQL.
4. Provides an opportunity to review the changes, for editing and correcting errors in the migrated objects.
5. Creates the migrated objects in the target MySQL server. If there are errors, you can return to the previous step and correct them, and retry the target creation.
6. Copy data of the migrated tables from the source RDBMS to MySQL.

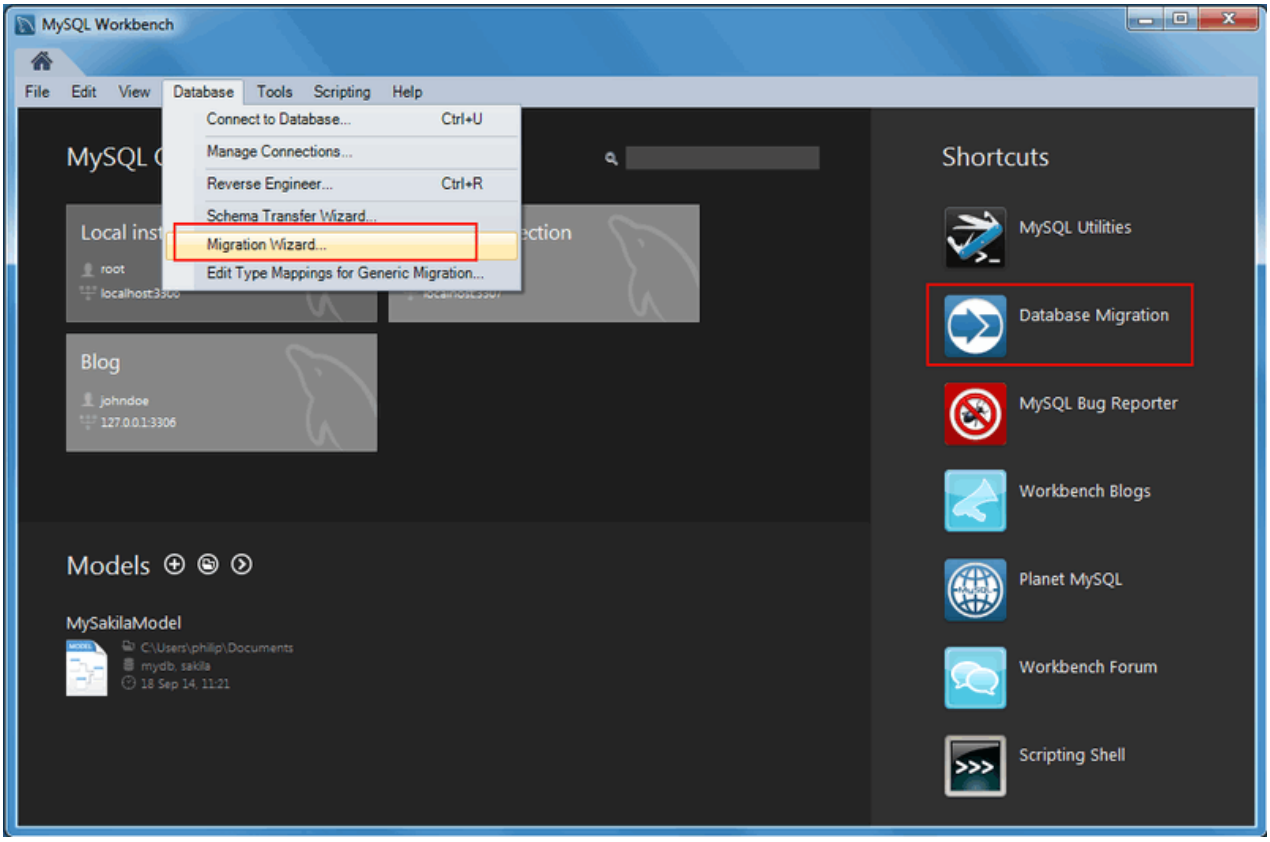
MySQL Workbench provides support for migrating from some specific RDBMS products. The Migration Wizard will provide the best results when migrating from such products. However, in some cases, other unsupported database products can also be migrated by using its Generic database support, as long as you have an ODBC driver for it. In this case, the migration will be less automatic, but should still work nonetheless.

10.2.1 A visual guide to performing a database migration

This example will migrate a Microsoft SQL Server database to MySQL, and include a screenshot for each step.

From MySQL Workbench, choose Database, Migrate to open the migration wizard.

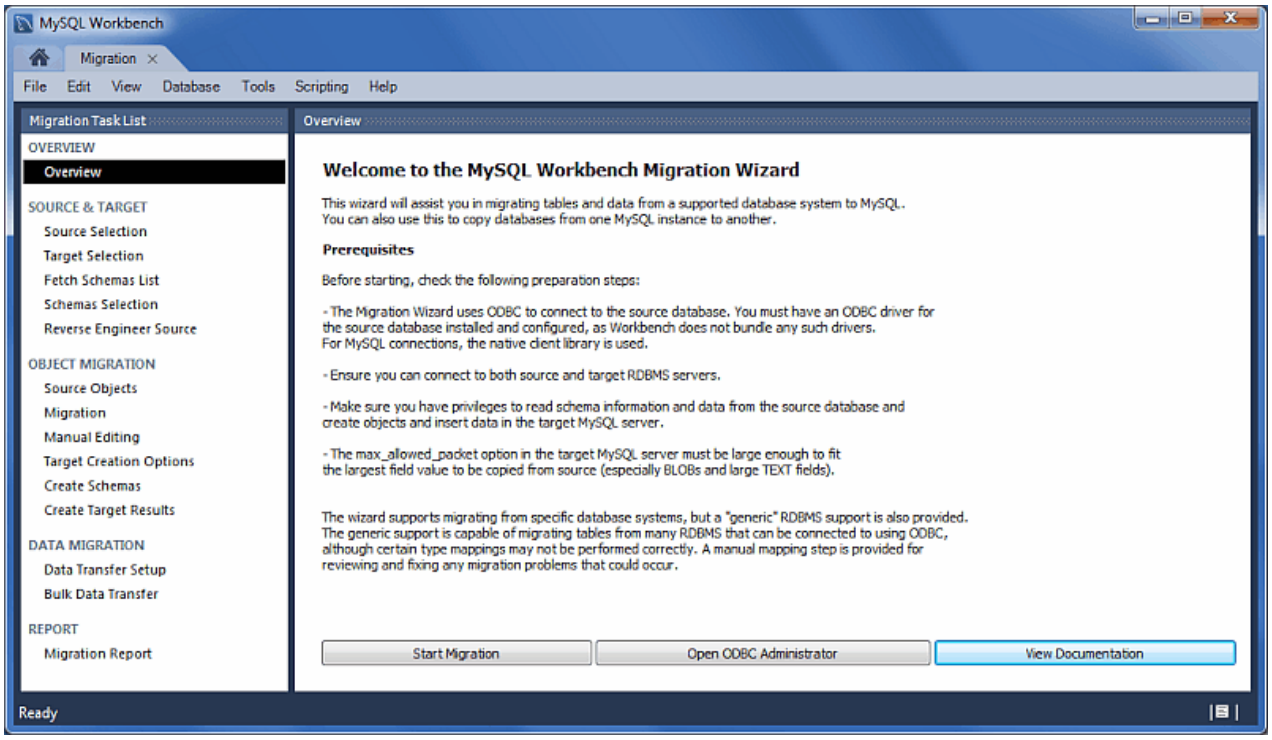
Figure 10.2 MySQL Workbench migration: Start



Read the migration wizard overview:

Overview

Figure 10.3 MySQL Workbench migration: Overview


MySQL Workbench
Migration
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Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
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Target Selection
Fetch Schemas List
Schemas Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Overview
Welcome to the MySQL Workbench Migration Wizard
This wizard will assist you in migrating tables and data from a supported database system to MySQL.
You can also use this to copy databases from one MySQL instance to another.
Prerequisites
Before starting, check the following preparation steps:
- The Migration Wizard uses ODBC to connect to the source database. You must have an ODBC driver for the source database installed and configured, as Workbench does not bundle any such drivers.
For MySQL connections, the native client library is used.
- Ensure you can connect to both source and target RDBMS servers.
- Make sure you have privileges to read schema information and data from the source database and create objects and insert data in the target MySQL server.
- The max_allowed_packet option in the target MySQL server must be large enough to fit the largest field value to be copied from source (especially BLOBs and large TEXT fields).
The wizard supports migrating from specific database systems, but a "generic" RDBMS support is also provided. The generic support is capable of migrating tables from many RDBMS that can be connected to using ODBC, although certain type mappings may not be performed correctly. A manual mapping step is provided for reviewing and fixing any migration problems that could occur.
Start Migration
Open ODBC Administrator
View Documentation
Ready

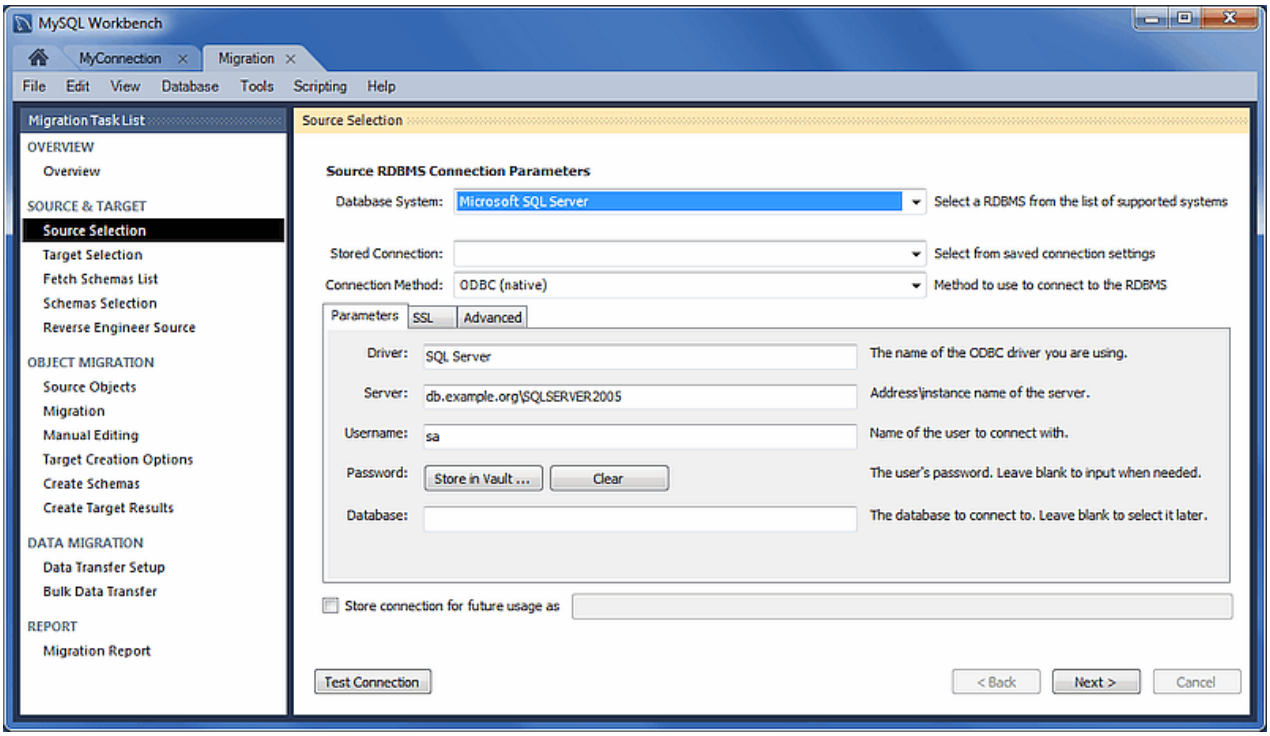
It describes the prerequisites and requirements that should be understood before proceeding further. The Open ODBC Administrator option will load `odbcad32.exe`, and is used to confirm that the ODBC Driver for SQL Server is installed, and to make configuration changes if needed.

Click Start Migration to continue.

Source Selection

Select the source RDBMS that is migrating to MySQL. Choose the **Database System** that is being migrated, and the other connection parameters will change accordingly.

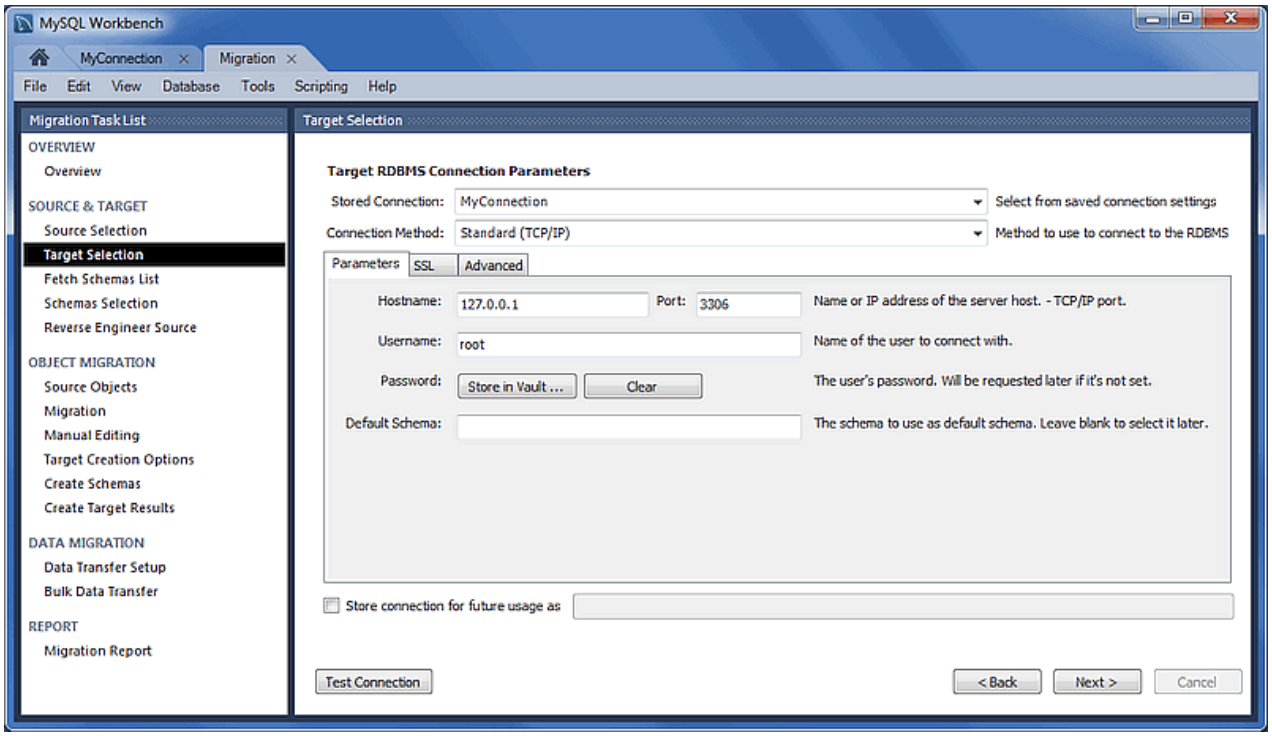
Figure 10.4 MySQL Workbench migration: Source Selection (Parameters)



Target Selection

The target is the MySQL database that will contain the newly migrated database. The current Workbench MySQL connections will be available here, or you can choose Manage DB Connections to create a new connection.

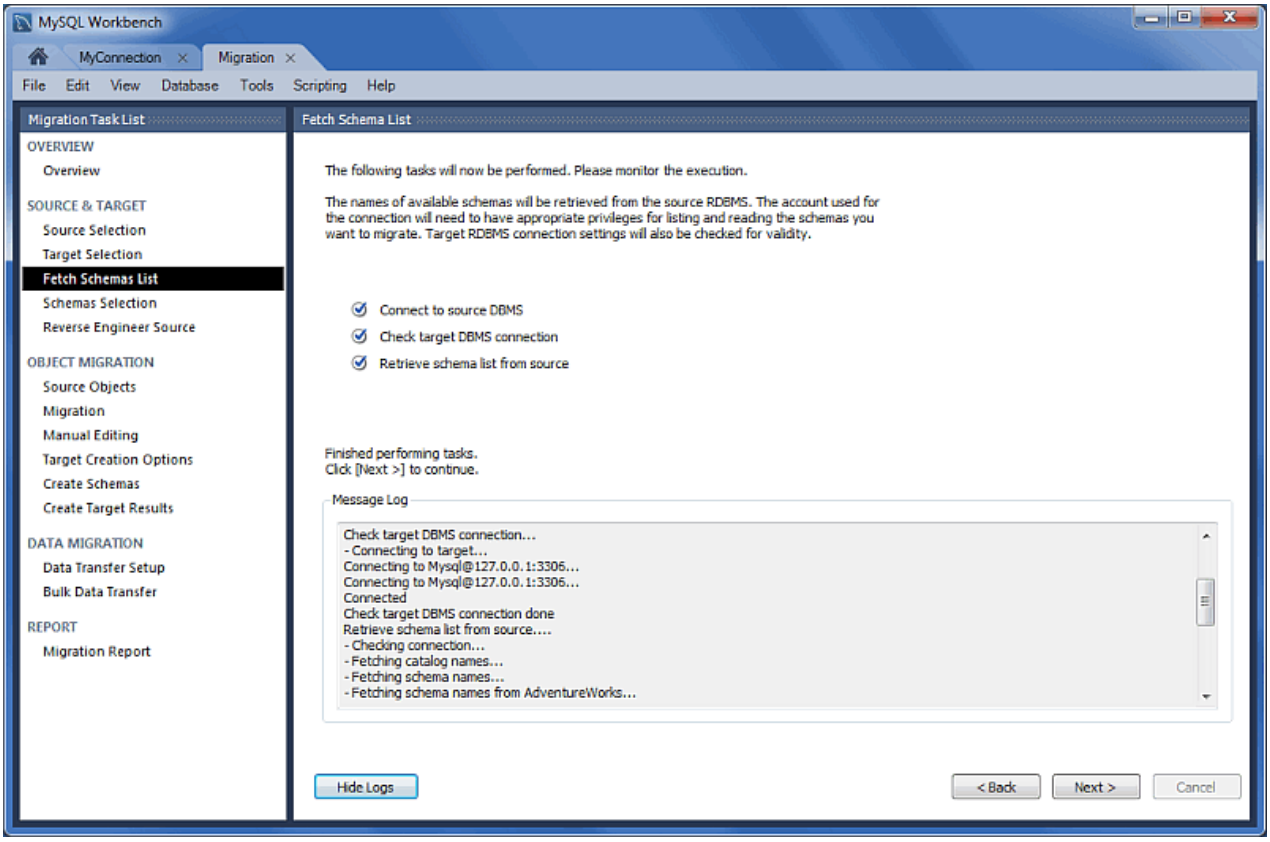
Figure 10.5 MySQL Workbench migration: Target selection



Fetch Schemata List

The Schemata list is retrieved from both the source and target RDBMS. This is an automated and informational step that reports connection related errors and/or general log information. Press Next to continue.

Figure 10.6 MySQL Workbench migration: Fetch Schemata List



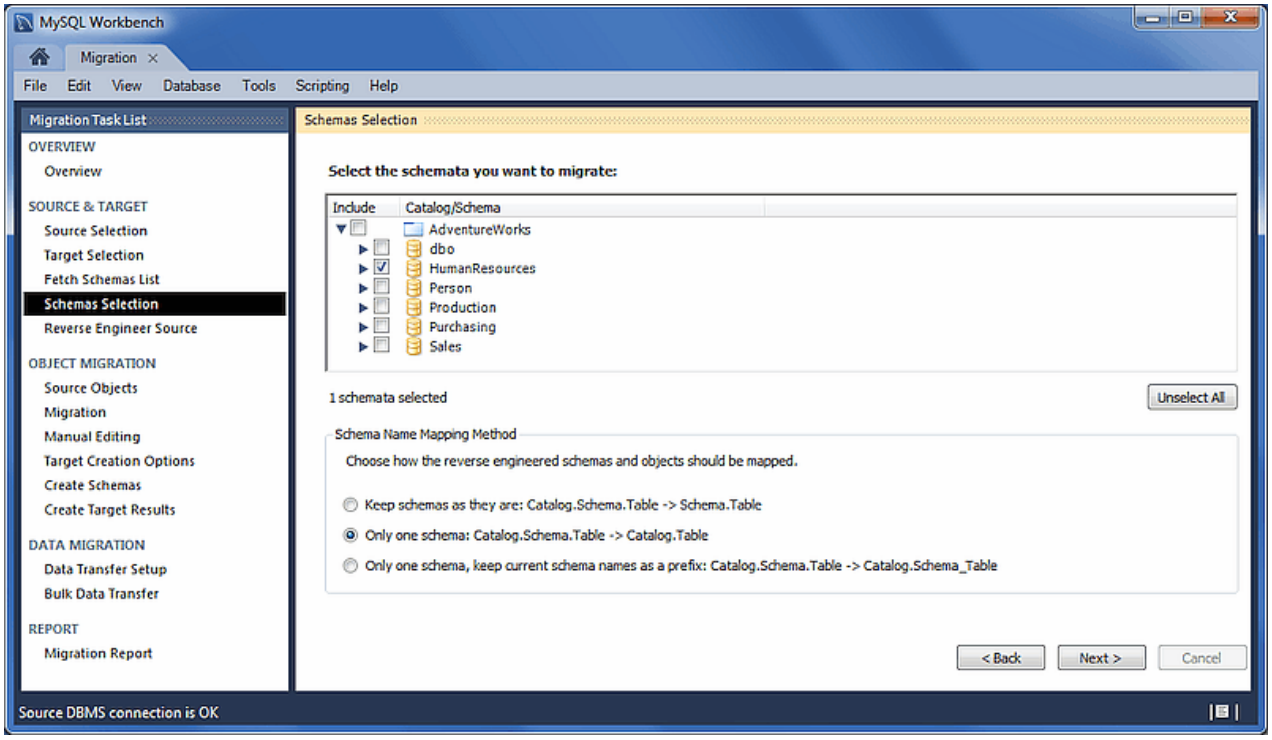
Schemata Selection

Choose the schemata you want to migrate.

"Schema Name Mapping Method" options while migrating Microsoft SQL Server:

- Keep schemata as they are: Catalog.Schema.Table -> Schema.Table: This will create multiple databases, one per schema.
- Only one schema: Catalog.Schema.Table -> Catalog.Table: Merges each schema into a single database.
- Only one schema, keep current schema names as a prefix: Catalog.Schema.Table -> Catalog.Schema_table: Preserves the schema name as a prefix.

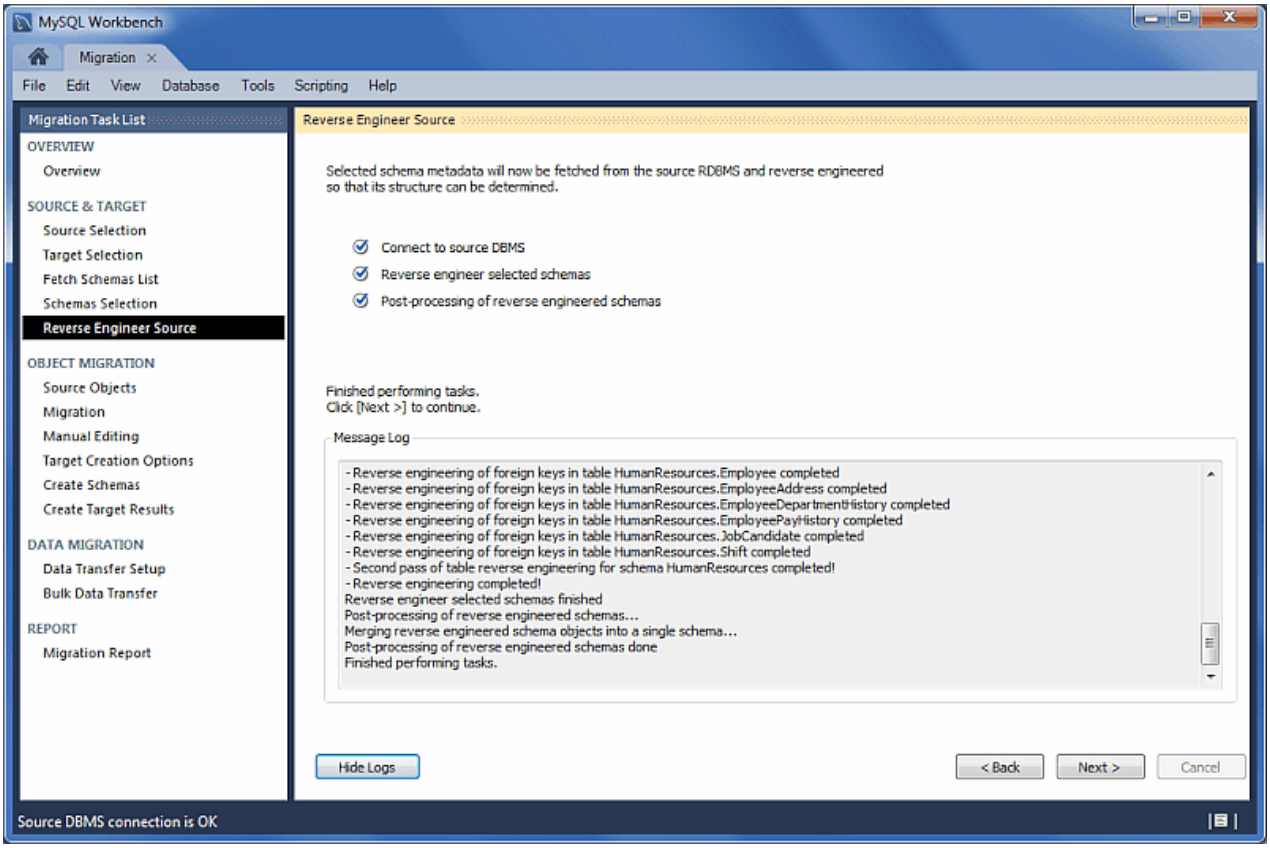
Figure 10.7 MySQL Workbench migration: Schemata Selection



Reverse Engineer Source

The source metadata is fetched from the source RDBMS, and reverse engineered. This is an automated and informational step that reports related errors and/or general log information. View the logs and then press Next to continue.

Figure 10.8 MySQL Workbench migration: Reverse Engineer Source


MySQL Workbench
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Target Selection
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Schemas Selection
Reverse Engineer Source
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Create Schemas
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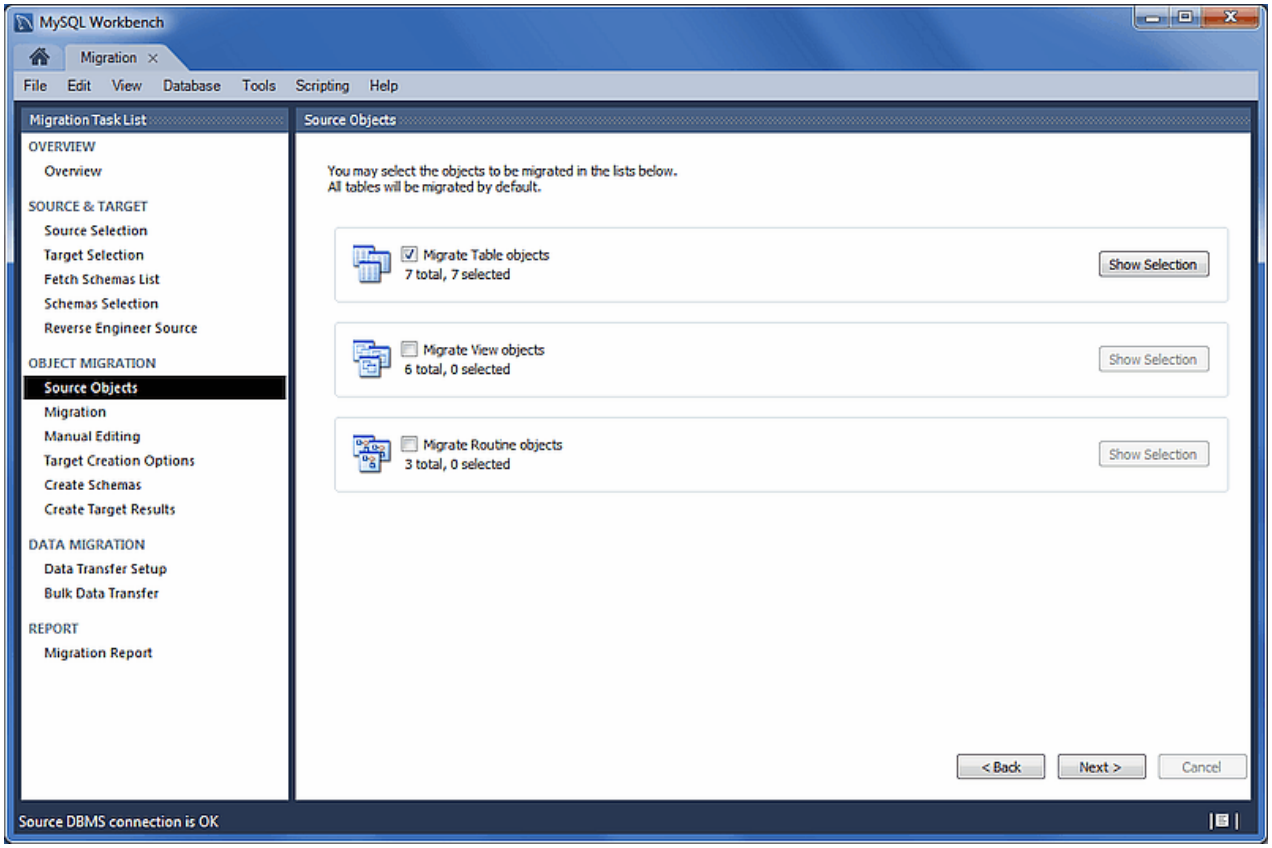
REPORT
Migration Report
Reverse Engineer Source
Selected schema metadata will now be fetched from the source RDBMS and reverse engineered so that its structure can be determined.
Connect to source DBMS
Reverse engineer selected schemas
Post-processing of reverse engineered schemas
Finished performing tasks.
Click [Next >] to continue.
Message Log
- Reverse engineering of foreign keys in table HumanResources.Employee completed
- Reverse engineering of foreign keys in table HumanResources.EmployeeAddress completed
- Reverse engineering of foreign keys in table HumanResources.EmployeeDepartmentHistory completed
- Reverse engineering of foreign keys in table HumanResources.EmployeePayHistory completed
- Reverse engineering of foreign keys in table HumanResources.JobCandidate completed
- Reverse engineering of foreign keys in table HumanResources.Shift completed
- Second pass of table reverse engineering for schema HumanResources completed!
- Reverse engineering completed!
Reverse engineer selected schemas finished
Post-processing of reverse engineered schemas...
Merging reverse engineered schema objects into a single schema...
Post-processing of reverse engineered schemas done
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel
Source DBMS connection is OK

Source Objects

The discovered objects from the **Reverse Engineer Source** stage are revealed and made available. This includes Table, View, and Routine objects, with only the Table objects being selected by default.

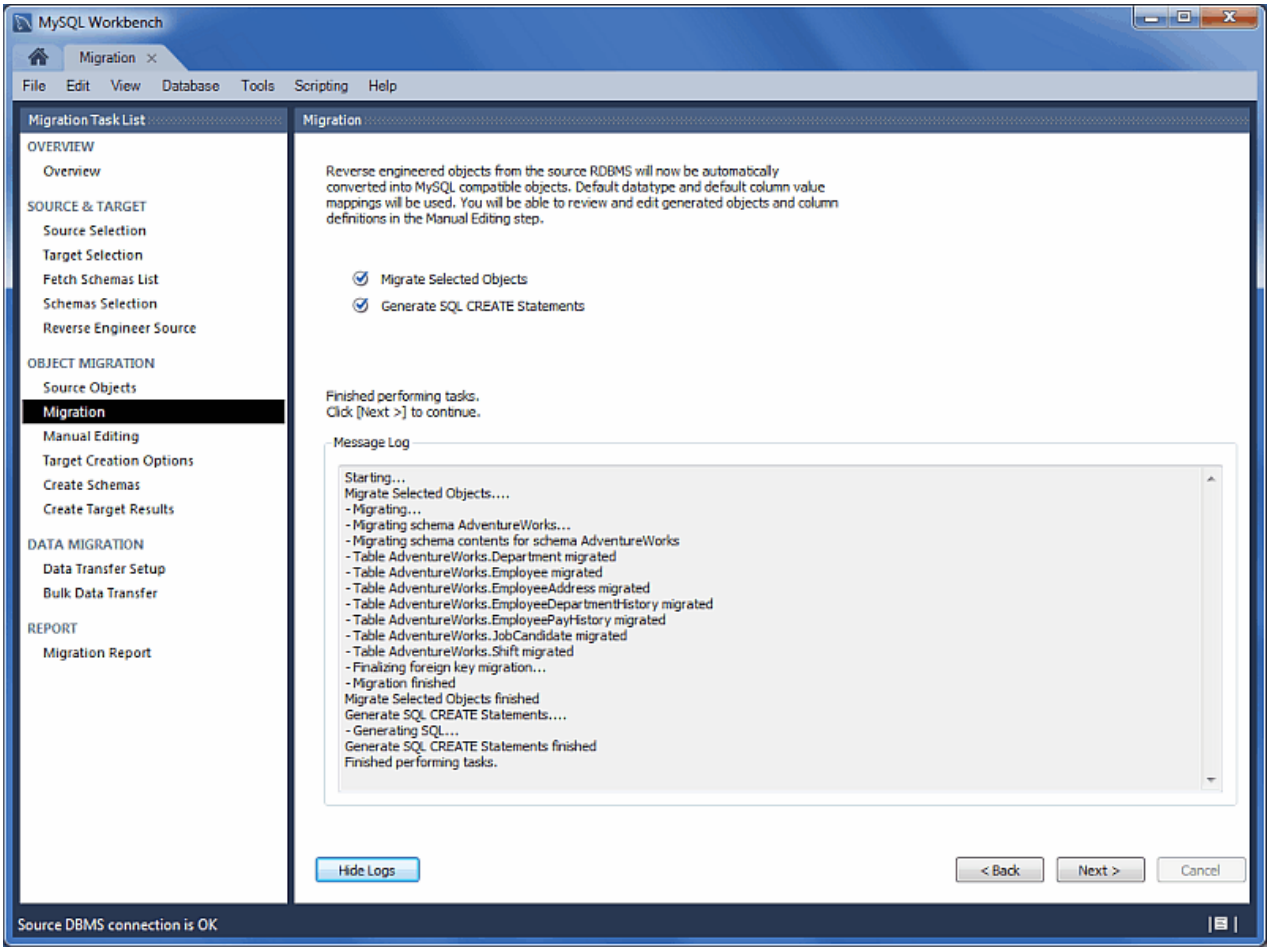
Figure 10.9 MySQL Workbench migration: Source Objects



Migration

The migration process now converts the selected objects into MySQL compatible objects. View the logs and then proceed.

Figure 10.10 MySQL Workbench migration: Migration



Manual Editing

There are three sections to edit here, which are selected via the **View** select box on the top right. The Show Code and Messages button is available with every view, and it will show the generated MySQL code that corresponds to the selected object.

- Migration Problems: This will either report problems or display "No mapping problems found." It is an informational screen.
- All Objects: An object view that allows you to view and edit the object definitions. Double-click on a row to modify a target objects name.
- Column Mappings: Shows all of the table column mappings, and allows you to individually review and fix the mapping for all column types, default values, and other attributes.

Figure 10.11 MySQL Workbench migration: Manual Editing (Migration Problems)

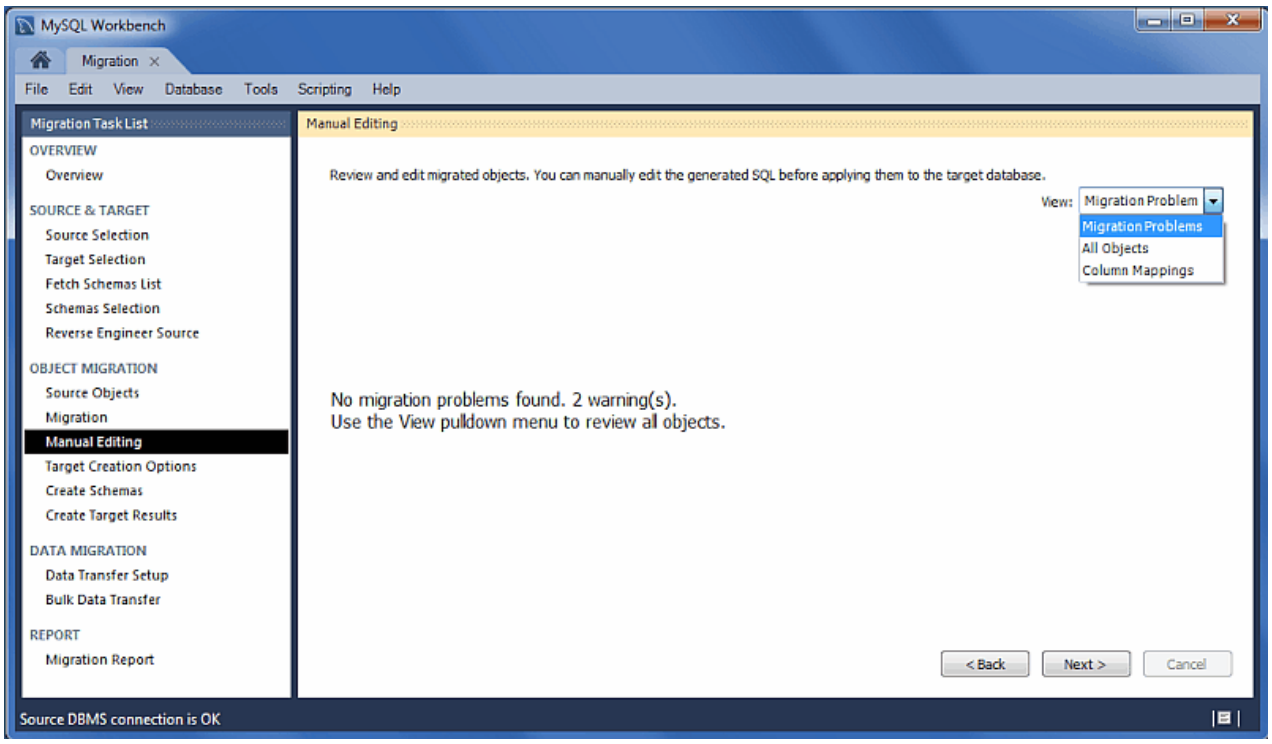


Figure 10.12 MySQL Workbench migration: Manual Editing (All Objects)

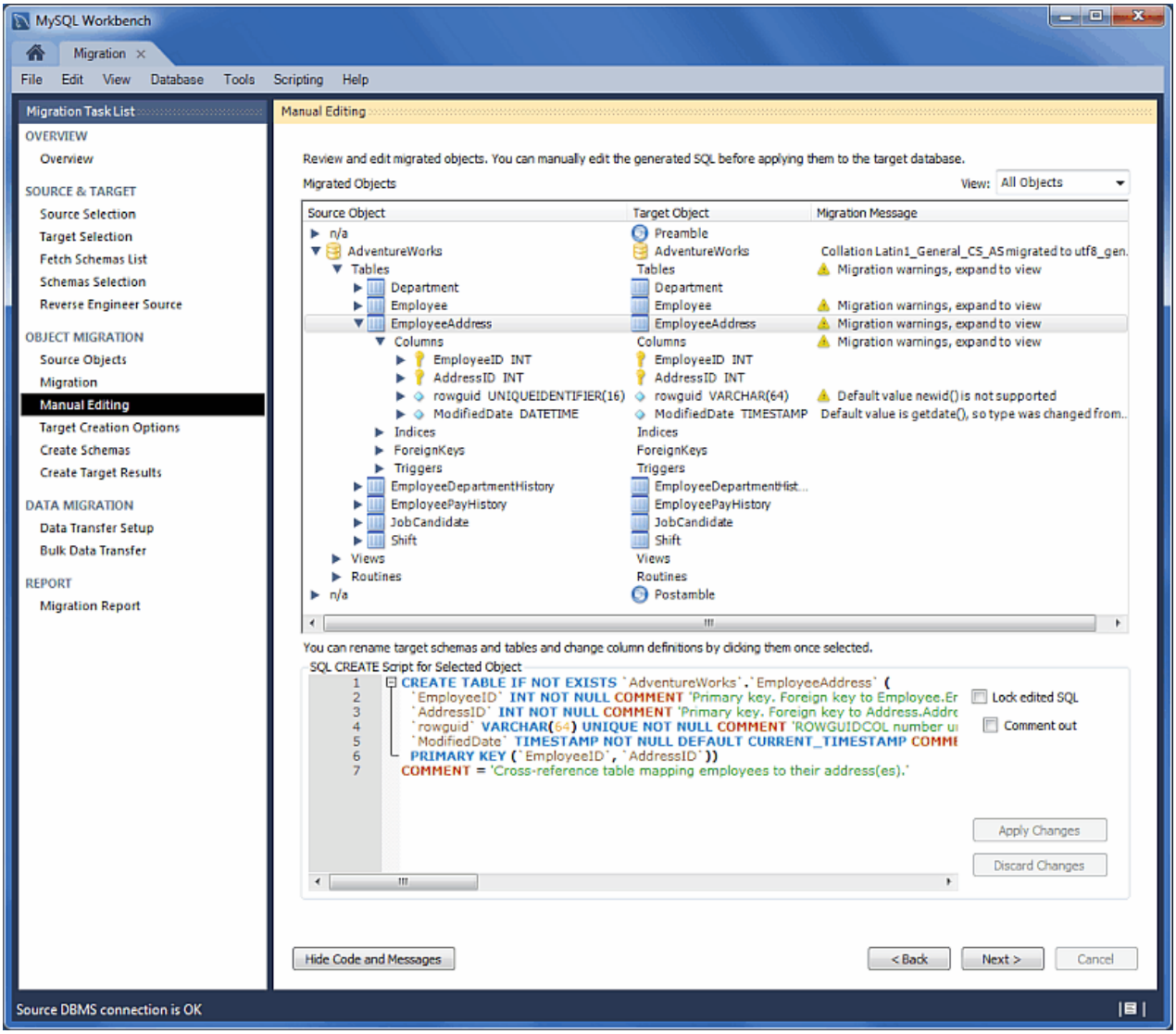
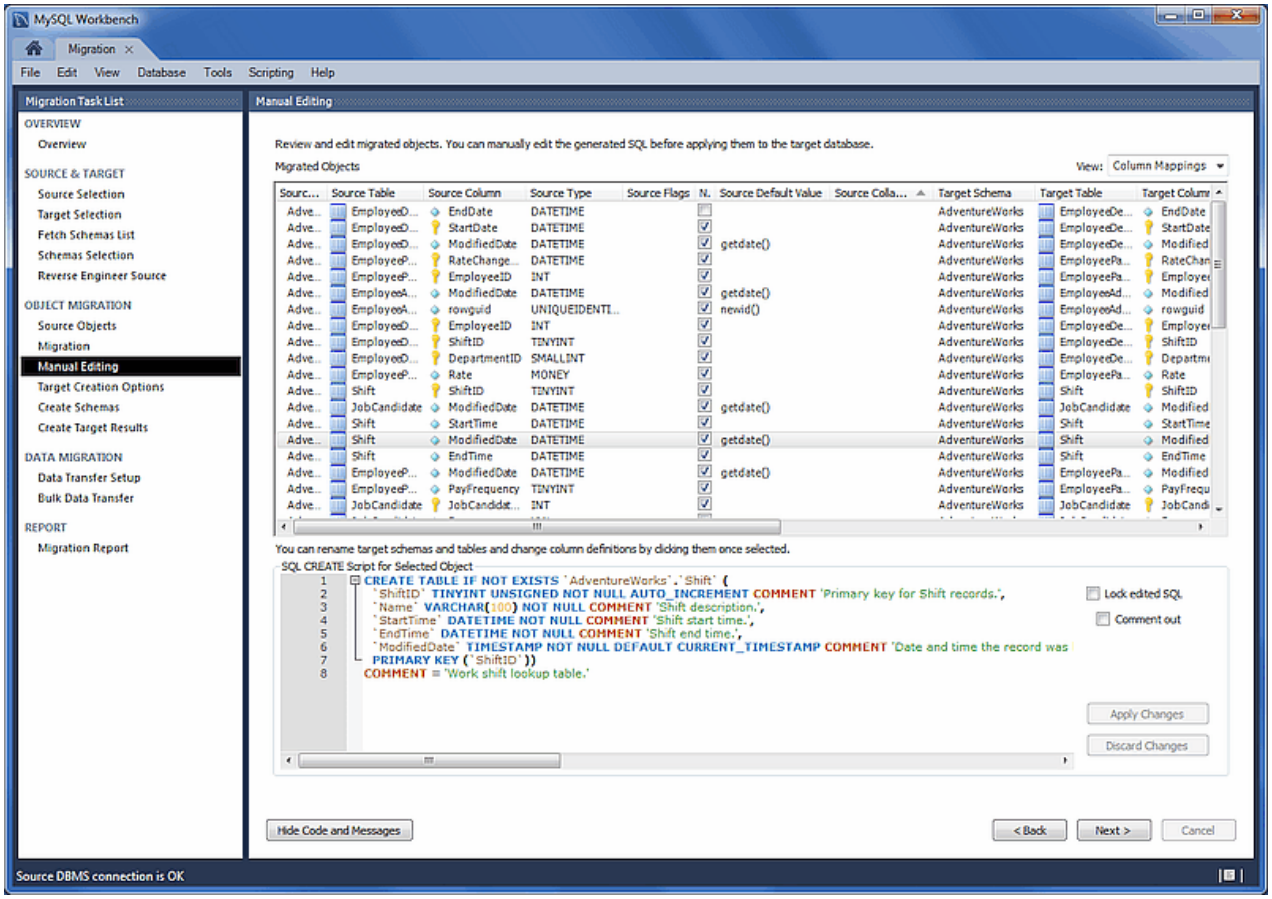


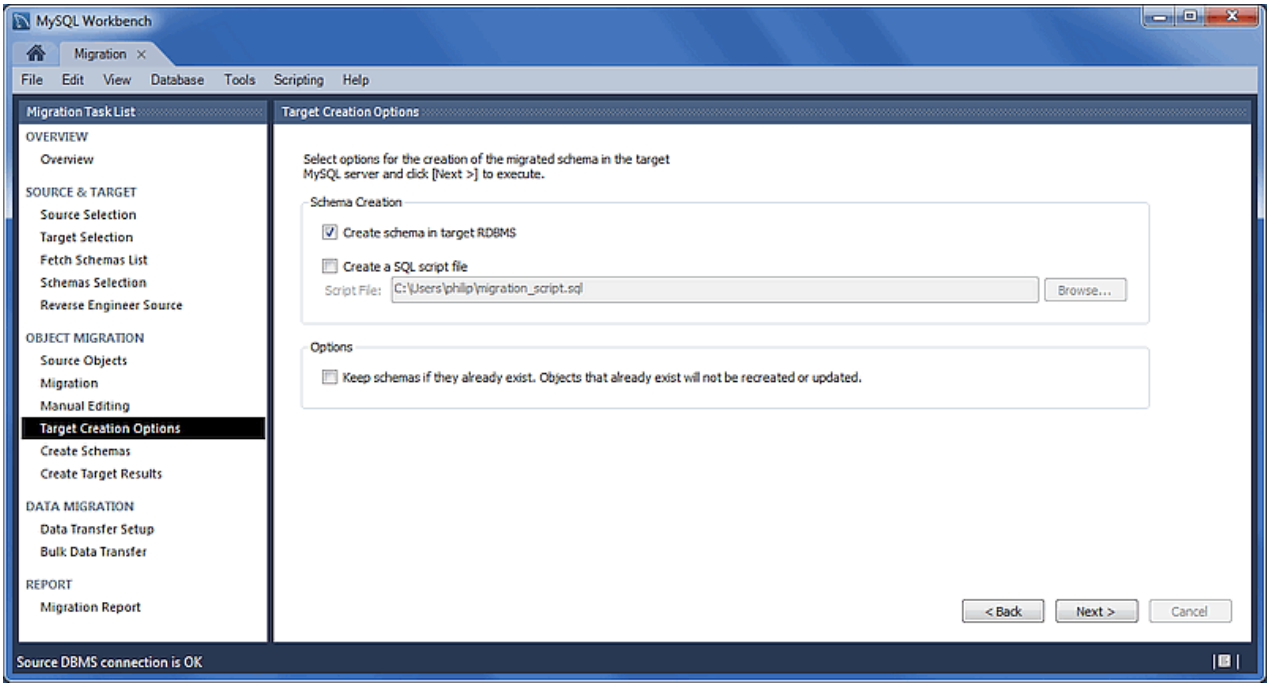
Figure 10.13 MySQL Workbench migration: Manual Editing (Column Mappings)



Target Creation Options

The schema may be created by either adding it to the target RDBMS, creating an SQL script file, or both.

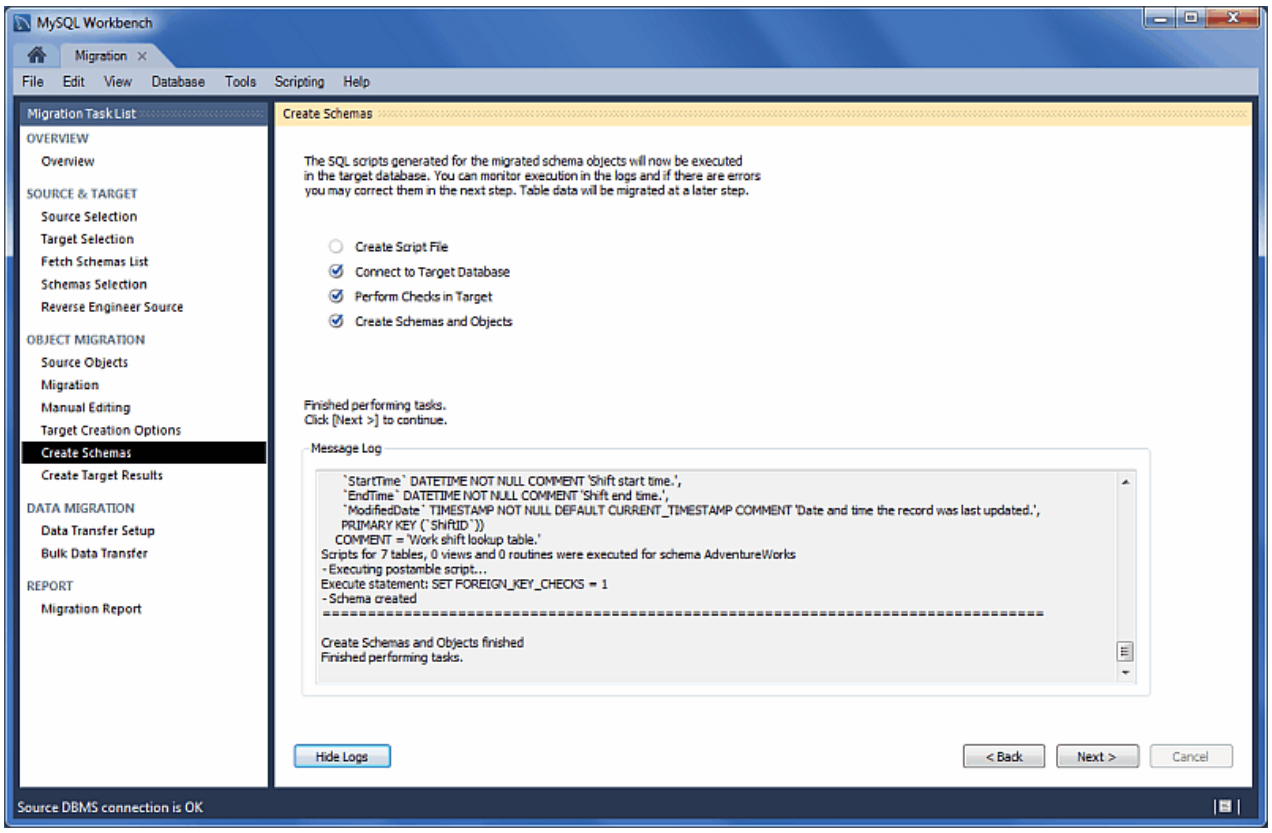
Figure 10.14 MySQL Workbench migration: Target Creation Options



Create Schemata

Now the schemata is created. The complete log is also available here.

Figure 10.15 MySQL Workbench migration: Create Schemata


MySQL Workbench
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Reverse Engineer Source
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Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Create Schemas
The SQL scripts generated for the migrated schema objects will now be executed in the target database. You can monitor execution in the logs and if there are errors you may correct them in the next step. Table data will be migrated at a later step.
Create Script File
Connect to Target Database
Perform Checks in Target
Create Schemas and Objects
Finished performing tasks.
Click [Next >] to continue.
Message Log
`StartTime` DATETIME NOT NULL COMMENT 'Shift start time.',
`EndTime` DATETIME NOT NULL COMMENT 'Shift end time.',
`ModifiedDate` TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP COMMENT 'Date and time the record was last updated.',
PRIMARY KEY (`ShiftID`))
COMMENT = 'Work shift lookup table.'
Scripts for 7 tables, 0 views and 0 routines were executed for schema AdventureWorks
- Executing postamble script...
Execute statement: SET FOREIGN_KEY_CHECKS = 1
- Schema created
Create Schemas and Objects finished
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel
Source DBMS connection is OK

Create Target Results

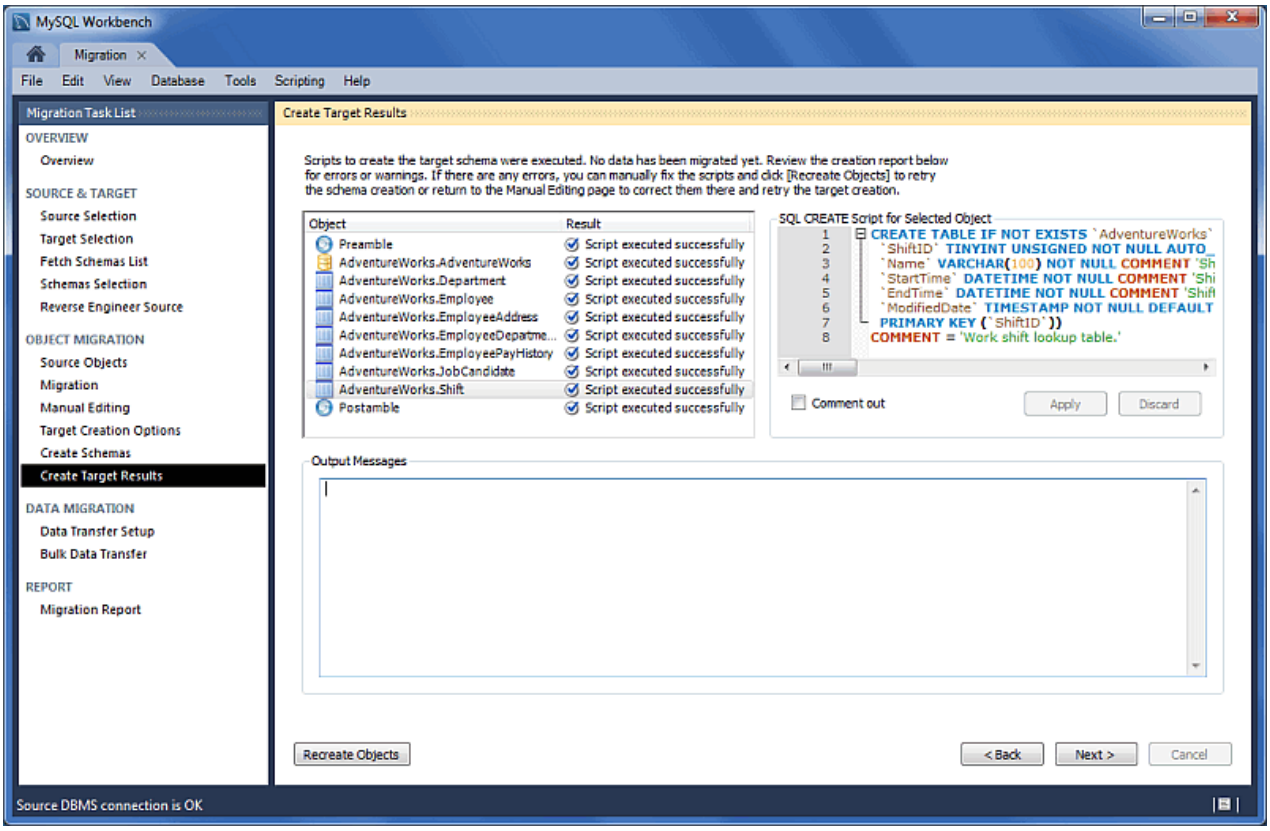
The generated objects are listed here, along with the error messages if any exist.

The migration code may also be viewed and edited here. To make changes, select an object, edit the query code, and press Apply. Repeat this process for each object that will be edited. And then, press Recreate Objects to save the results.

Note

The Recreate Objects operation is required to save any changes here. It will then execute the previous migration step (**Create Schemata**) with the modified code, and then continue the migration process. This also means that the previously saved schema will be dropped.

Figure 10.16 MySQL Workbench migration: Create Target Results



Data Transfer Setup

The next step transfers data from the source RDBMS to the target MySQL database. The setup screen includes the following options:

Data Copy:

- *Online copy of table data to target RDBMS*: This (default) will copy the data to the target RDBMS.
- *Create a batch file to copy the data at another time*: The data may also be dumped to a file that can be executed at a later time, or be used as a backup. This script uses a MySQL connection to transfer the data.
- *Create a shell script to use native server dump and load abilities for fast migration*: Unlike the simple batch file that performs a live online copy, this generates a script to be executed on the *source* host to then generate a Zip file containing all of the data and information needed to migrate the data locally on the target host. Copy and extract the generated Zip file on the target host and then execute the import script (on the target host) to import the data into MySQL using a LOAD DATA call.

  This faster method avoids the need to traffic all data through MySQL Workbench, or to have a permanent network connection between the MySQL servers.

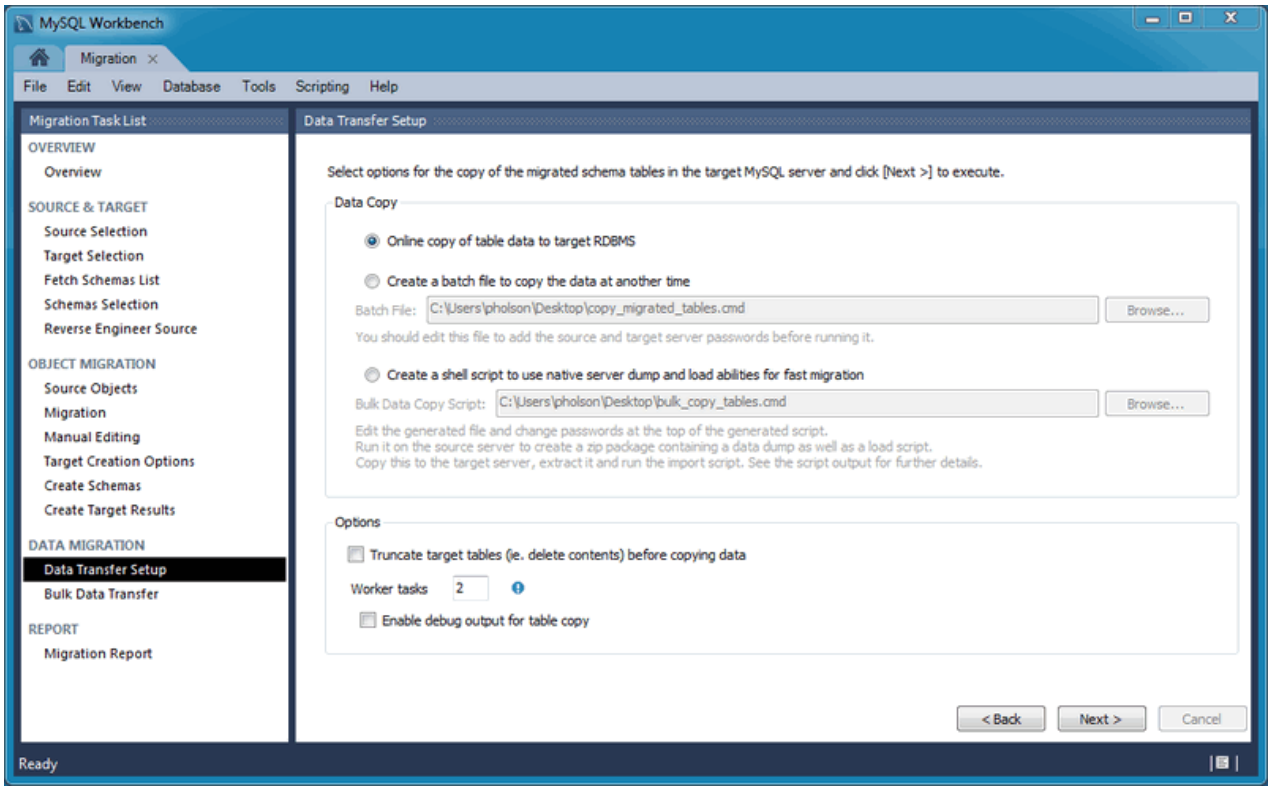
Note

This option was added in MySQL Workbench 6.3.0.

Options:

- Truncate target tables before copying data: In case the target database already exists, this will delete said data.
- Worker tasks: The default value is 2. This is the number of tasks (database connections) used while copying the data.
- Enable debug output for table copy: Shows debugging information.

Figure 10.17 MySQL Workbench migration: Data Transfer Setup


MySQL Workbench
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DATA MIGRATION
Data Transfer Setup
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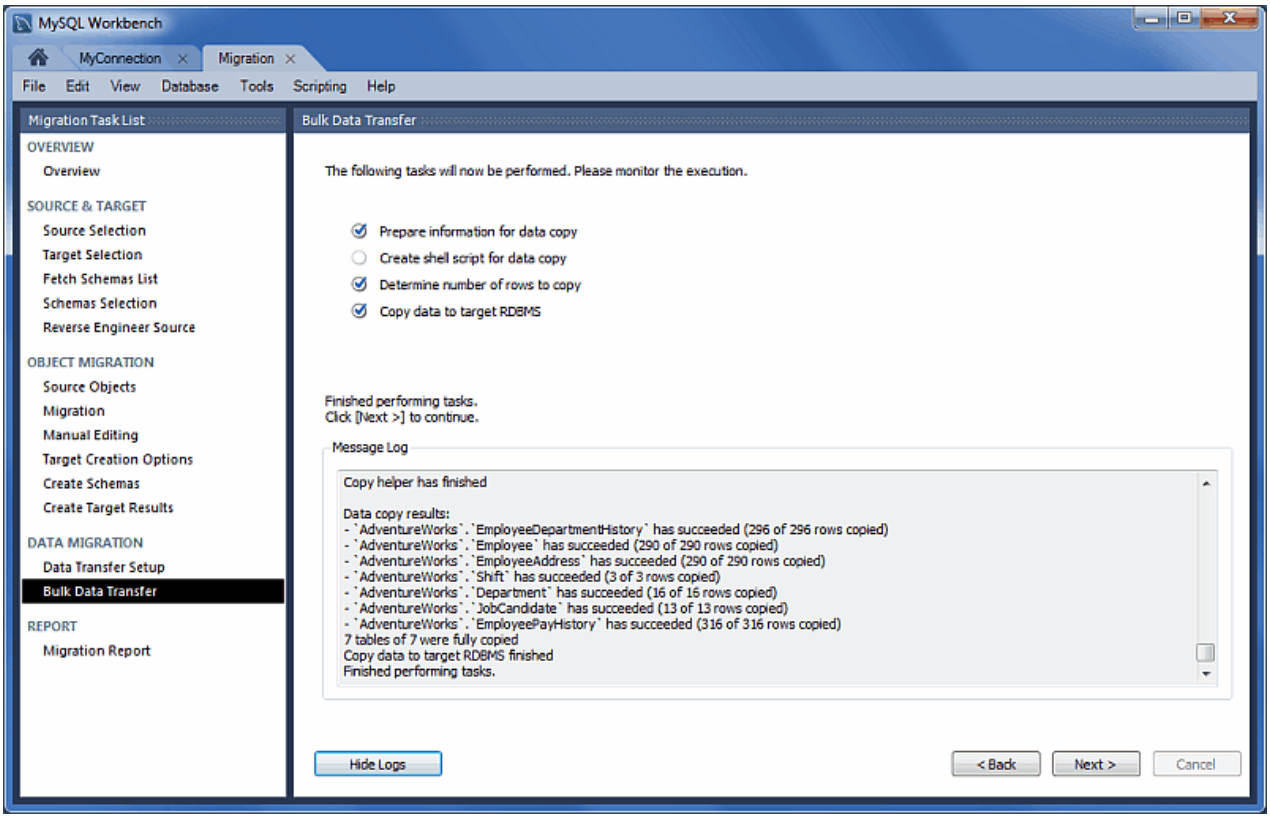
REPORT
Migration Report
Data Transfer Setup
Select options for the copy of the migrated schema tables in the target MySQL server and click [Next >] to execute.
Data Copy
Online copy of table data to target RDBMS
Create a batch file to copy the data at another time
Batch File: C:\Users\pholson\Desktop\copy_migrated_tables.cmd
Browse...
You should edit this file to add the source and target server passwords before running it.
Create a shell script to use native server dump and load abilities for fast migration
Bulk Data Copy Script: C:\Users\pholson\Desktop\bulk_copy_tables.cmd
Browse...
Edit the generated file and change passwords at the top of the generated script.
Run it on the source server to create a zip package containing a data dump as well as a load script.
Copy this to the target server, extract it and run the import script. See the script output for further details.
Options
Truncate target tables (ie. delete contents) before copying data
Worker tasks 2
Enable debug output for table copy
< Back
Next >
Cancel
Ready

Bulk Data Transfer

Depending on the selected option, this will either transfer the data to the target RDMS (default), generate a simple script for the online data transfer, or generate script to execute on the source host that then generates a Zip file containing both the transfer script and data that will be executed on the target host. Optionally, view the logs to confirm.

Figure 10.18 MySQL Workbench migration: Bulk Data Transfer


MySQL Workbench
MyConnection
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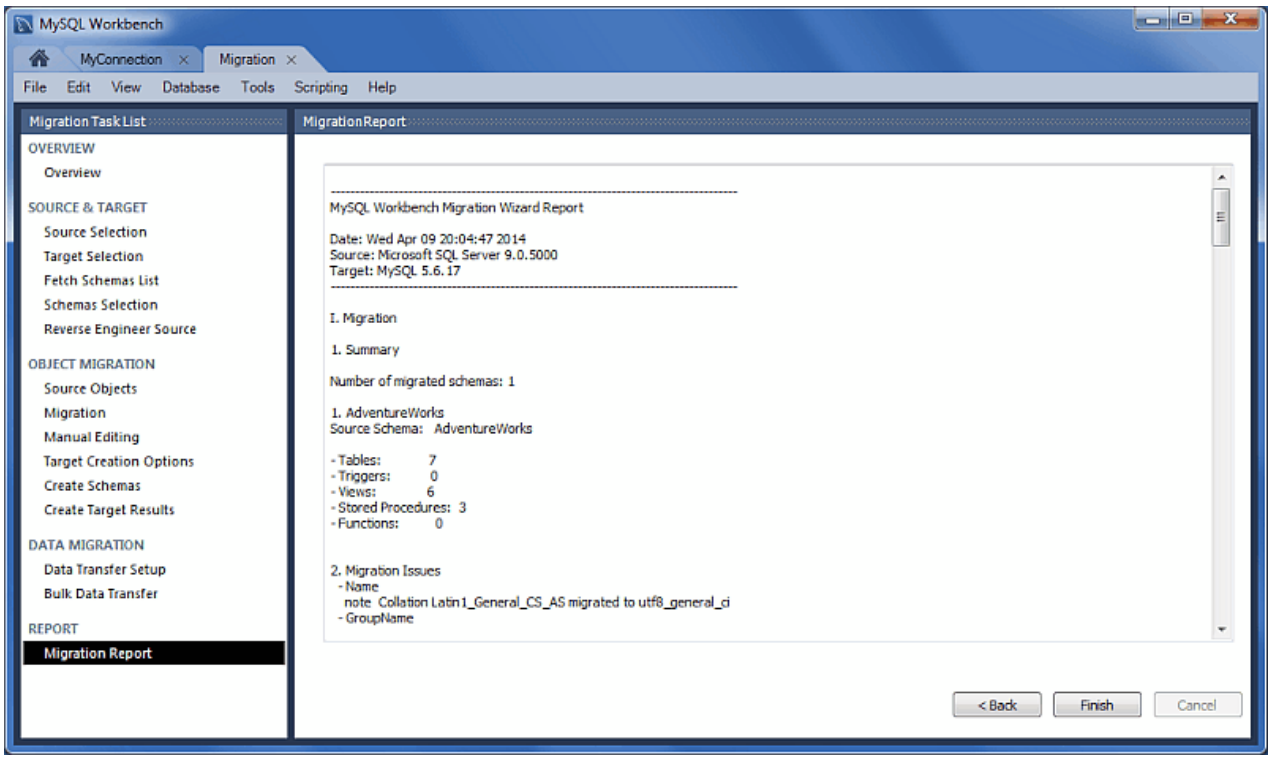
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Bulk Data Transfer
The following tasks will now be performed. Please monitor the execution.
Prepare information for data copy
Create shell script for data copy
Determine number of rows to copy
Copy data to target RDBMS
Finished performing tasks.
Click [Next >] to continue.
Message Log
Copy helper has finished
Data copy results:
- `AdventureWorks`.`EmployeeDepartmentHistory` has succeeded (296 of 296 rows copied)
- `AdventureWorks`.`Employee` has succeeded (290 of 290 rows copied)
- `AdventureWorks`.`EmployeeAddress` has succeeded (290 of 290 rows copied)
- `AdventureWorks`.`Shift` has succeeded (3 of 3 rows copied)
- `AdventureWorks`.`Department` has succeeded (16 of 16 rows copied)
- `AdventureWorks`.`JobCandidate` has succeeded (13 of 13 rows copied)
- `AdventureWorks`.`EmployeePayHistory` has succeeded (316 of 316 rows copied)
7 tables of 7 were fully copied
Copy data to target RDBMS finished
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel

Migration Report

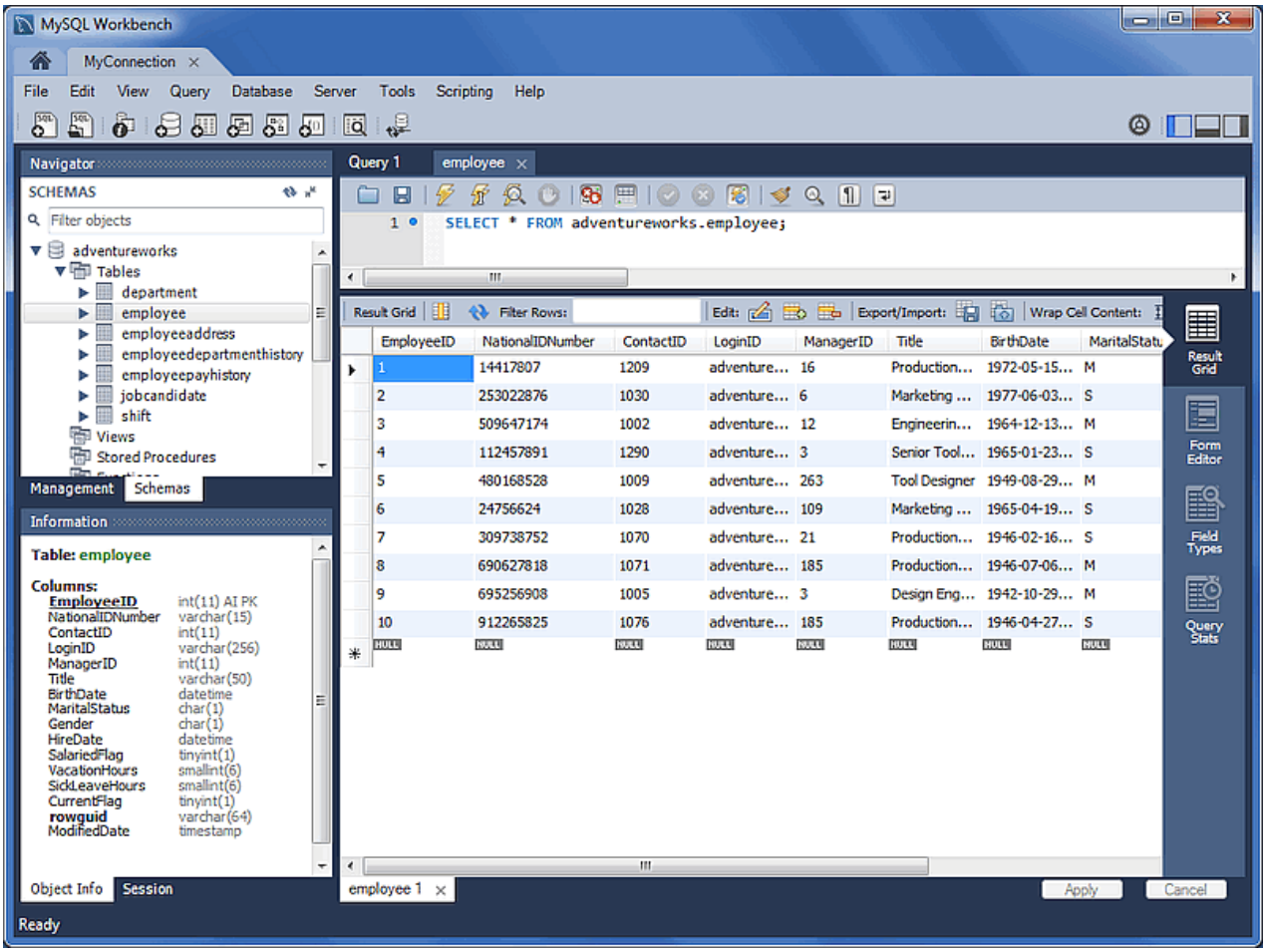
And finally, the migration report is available and summarizes the entire migration process.

Figure 10.19 MySQL Workbench migration: Migration Report



Pressing Finish will close the migration window. If you chose the online copy then the database can now be viewed within the MySQL Workbench SQL editor.

Figure 10.20 MySQL Workbench migration: Viewing the migrated database



Note

If a MySQL Workbench SQL Editor tab is already opened, then the schema list within the Object Browser must be refreshed in order to view the newly imported schema.

10.2.2 Migrating from supported databases

When a supported RDBMS product is being migrated, the MySQL Workbench Migration Wizard will automatically convert as much information as it can, but you may still be required to manually edit the automatically migrated schema for difficult cases, or when the default mapping is not as desired.

Generally speaking, only table information and its data are automatically converted to MySQL. Code objects such as views, stored procedures, and triggers, are not. But supported RDBMS products will be retrieved and displayed in the wizard. You can then manually convert them, or save them for converting at a later time.

The following RDBMS products and versions are currently tested and supported by the MySQL Workbench Migration Wizard, although other RDBMS products can also be migrated with Section 10.2.3, “Migrating from unsupported (generic) databases”

- Microsoft SQL Server 2000, 2005, 2008, 2012

- Microsoft Access 2007 and greater
- MySQL Server 4.1 and greater as the source, and MySQL Server 5.1 and greater as the target
- PostgreSQL 8.0 and greater
- SQL Anywhere
- SQLite
- Sybase Adaptive Server Enterprise 15.x and greater

10.2.3 Migrating from unsupported (generic) databases

Most ODBC compliant databases may be migrated using the generic database support. In this case, code objects will not be retrieved from the source database; only tables and data.

When using the generic support, column data types are mapped using the following steps:

1. It searches for the first entry in the Generic Datatype Mapping Table for the source type name. If the length/scale ranges of the entry matches the source column, it will pick that type. Otherwise, it continues searching.
2. If no matches were found in the generic table, then it tries to directly map the source type to a MySQL type of the same name.
3. If the source type name doesn't match any of the MySQL data types, then it is not converted and an error is logged. From here you can specify the target datatype in the **Manual Object Editing** step of the wizard.

10.3 Conceptual DBMS equivalents

Table 10.1 Conceptual equivalents between supported DBMS products and MySQL

Concept	MS SQL Server	Sybase ASE	PostgreSQL	MySQL	Note
Authentication	Yes	Yes	Yes	Yes	
Auto_Increment	Yes	Yes	Yes	Yes	PostgreSQL uses sequences for Auto_Increment.
Backup	Yes	Yes	Yes	Yes	See MySQL Enterprise Backup
Catalog	Yes	Yes	Yes	N/A	You can map a catalog into a schema and drop the , use the owner as the schema name or merge the owner and object name together. ownerobject
Constraints	Yes	Yes	Yes	Yes	
Data Dictionary				N/A	
Database	Yes	Yes	Yes	Yes	
Database Instance					
Dump	Yes	Yes	Yes	Yes	`mysqldump`
Events	Yes	Yes	Yes	Yes	
Foreign Keys	Yes	Yes	Yes	Yes	

Concept	MS SQL Server	Sybase ASE	PostgreSQL	MySQL	Note
Full Text Search	Yes	Yes	Yes	Yes	In InnoDB as of MySQL Server 5.6, and in all versions of MyISAM
Index	Yes	Yes	Yes	Yes	
Information Schema	Yes	No	Yes	Yes	
Object Names Case Sensitivity	Depends on collation	Depends on collation	Mixed	Mixed	MySQL: sensitivity of database, table, and trigger names OS dependent; other object names are case insensitive. PostgreSQL: as specified in the SQL-99 standard, unquoted object names are treated as case insensitive while quoted object names are case sensitive. Unlike the standard, unquoted object names are converted to lowercase instead of uppercase.
Object Naming Conventions	Yes	Yes	Yes	Yes	
Packages	N/A	N/A	N/A	N/A	
Partitioning	Yes	Yes	Yes	Yes	
Performance Schema	N/A	N/A	Yes	Yes	
Permissions	Yes	Yes	Yes	Yes	
Primary Key	Yes	Yes	Yes	Yes	
Referential Integrity	Yes	Yes	Yes	Yes	Sybase ASE: referential integrity only through triggers.
Replication	Yes	Yes	Yes	Yes	
Role	Yes	Yes	Yes	N/A	Roles are not available in MySQL at the database level.
Schema	Yes	Yes*	Yes	Yes	Equivalent to database in MySQL. Sybase ASE: Schemata corresponds to user names.
Sequences	Yes*	Yes*	Yes	Yes*	Standalone sequence objects are not supported in MySQL. Similar functionality can be obtained with IDENTITY columns in MSSQL and AUTO_INCREMENT columns in MySQL
SQL Modes	Yes		Yes	Yes	SET_ANSI_* in MSSQL
Storage Engines	N/A	N/A	Yes*	Yes	PostgreSQL itself supports and uses only one storage engine (Postgresql). Other companies have added extra storage engines to PostgreSQL.
Stored Procedures	Yes	Yes	Yes	Yes	
Synonyms	N/A	N/A	N/A	N/A	

Concept	MS SQL Server	Sybase ASE	PostgreSQL	MySQL	Note
Table	Yes	Yes	Yes	Yes	
Tablespace	Yes	Yes*	Yes	N/A	MSSQL groups tables in schemata (unless referring to CREATE TABLESPACE). Sybase ASE: tables are grouped in schemata which are more like user names.
Temporary Tables	Yes	Yes	Yes	Yes	
Transactions	Yes	Yes	Yes	Yes	
Triggers	Yes	Yes	Yes	Yes	
UDFs	Yes	Yes	Yes	Yes	
Unicode	Yes	Yes	Yes	Yes	
Unique Key	Yes	Yes	Yes	Yes	
User	Yes	Yes	Yes	Yes	
Views	Yes	Yes	Yes	Yes	

Handling Microsoft SQL Server and MySQL structural differences

A Microsoft SQL Server database is made up of one catalog and one or more schemata. MySQL only supports one schema for each database (or rather, a MySQL database is a schema) so this difference in design must be planned for. The Migration Wizard must know how to handle the migration of schemata for the source (Microsoft SQL Server) database. It can either keep all of the schemata as they are (the Migration Wizard will create one database per schema), or merge them into a single MySQL database. Additional configure options include: either remove the schema names (the Migration Wizard will handle the possible name collisions that may appear along the way), and an option to add the schema name to the database object names as a prefix.

10.4 Microsoft Access Migration

Note

This feature was added in MySQL Workbench 6.2.0.

General Information

Microsoft Windows is required because Microsoft Access ODBC drivers are only available on Windows. As for the destination MySQL server, you can have it in the same local machine or elsewhere in your network.

Preparing a Microsoft Access Database for Migration

Microsoft Access stores relationship/foreign key information in an internal table called **MSysRelationships**. That table is protected against read access even to the Admin user, so if you try to migrate without opening up access to it, then you will get an error like this:

```
[42000] [Microsoft][ODBC Microsoft Access Driver] Record(s) cannot be read; no read permission on 'msysobjects
```

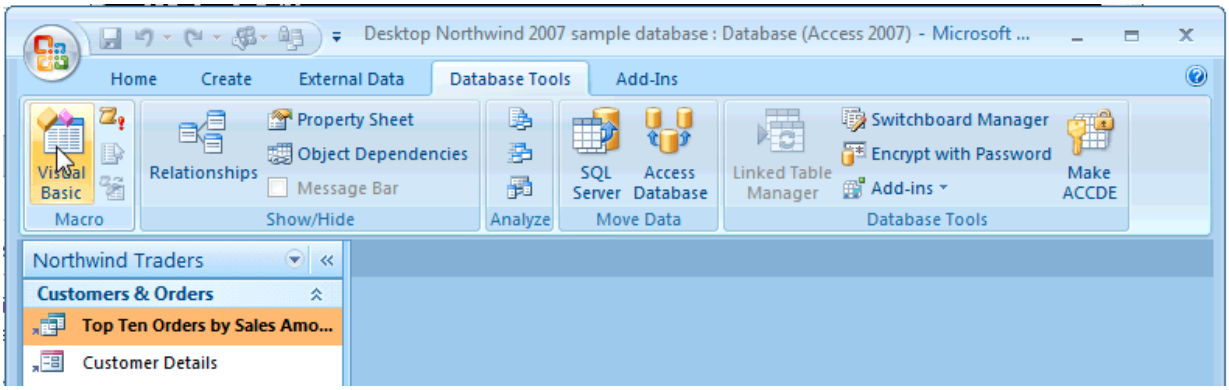
The steps to grant read access to the Admin are explained below.

Note

The screenshots in this documentation use Microsoft Access 2007.

- Open up database in Microsoft Access
- Under the Database Tools menu, click the Visual Basic macro button to open the Visual Basic (VB) console.

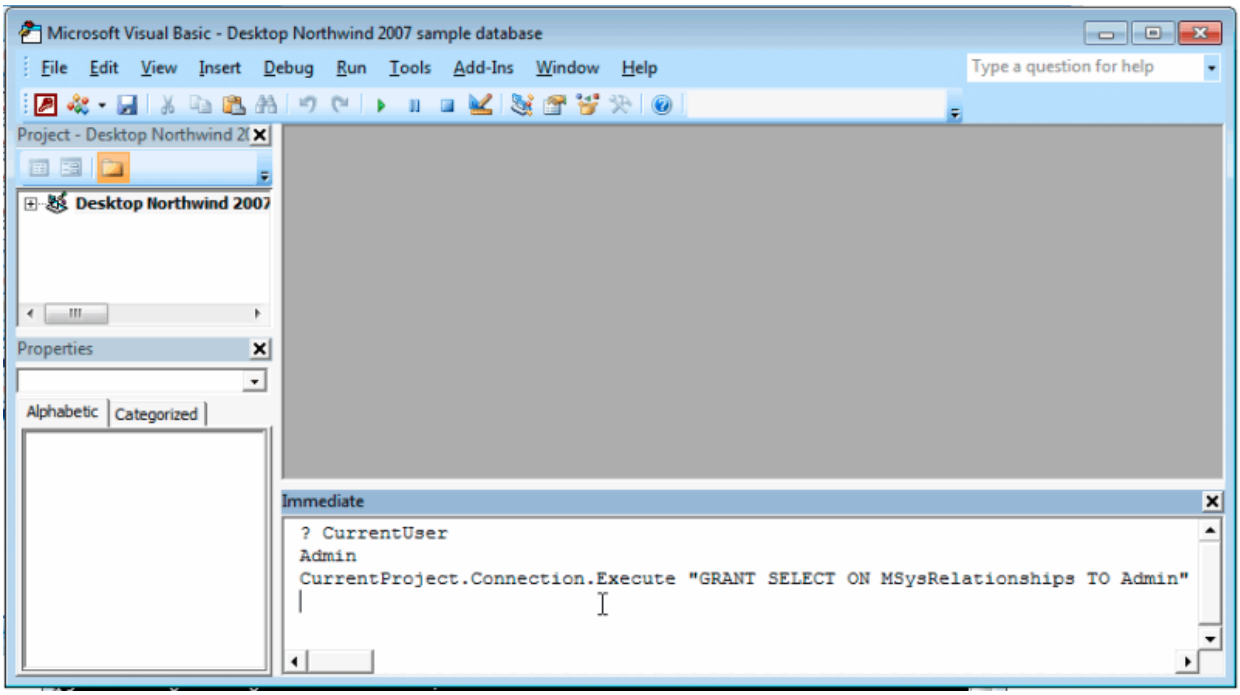
Figure 10.21 Locating the Visual Basic Macro Database Tool



- To confirm that you're logged in as the "Admin" user, locate the **Immediate** panel and type the "? CurrentUser" and press Enter. This should output "Admin" under "? CurrentUser" in the panel.
- Also in the **Immediate** panel, type the following command to grant access:

```
CurrentProject.Connection.Execute "GRANT SELECT ON MSysRelationships TO Admin"
```

Figure 10.22 GRANT SELECT ON MSysRelationships TO Admin

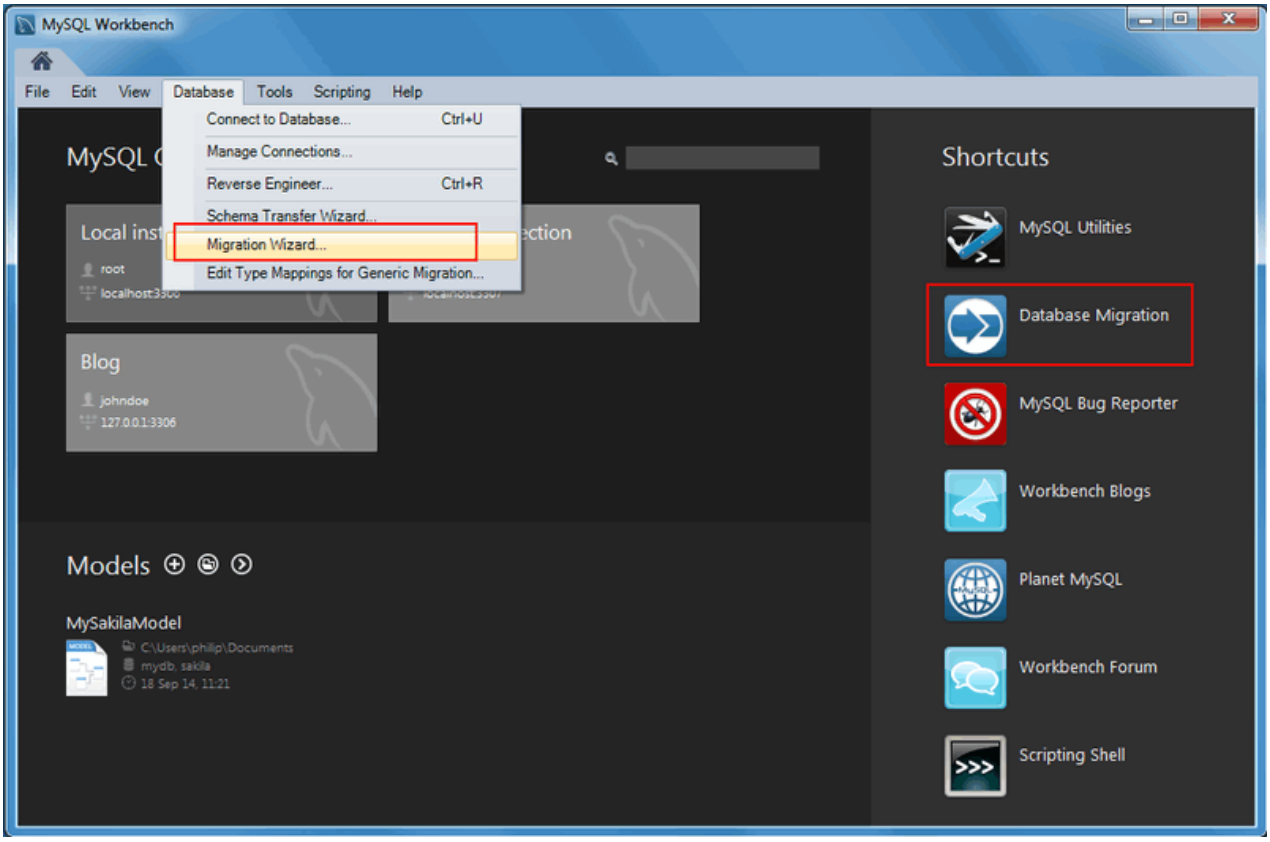


- Quit the Microsoft Access application

Start the MySQL Workbench Migration Wizard

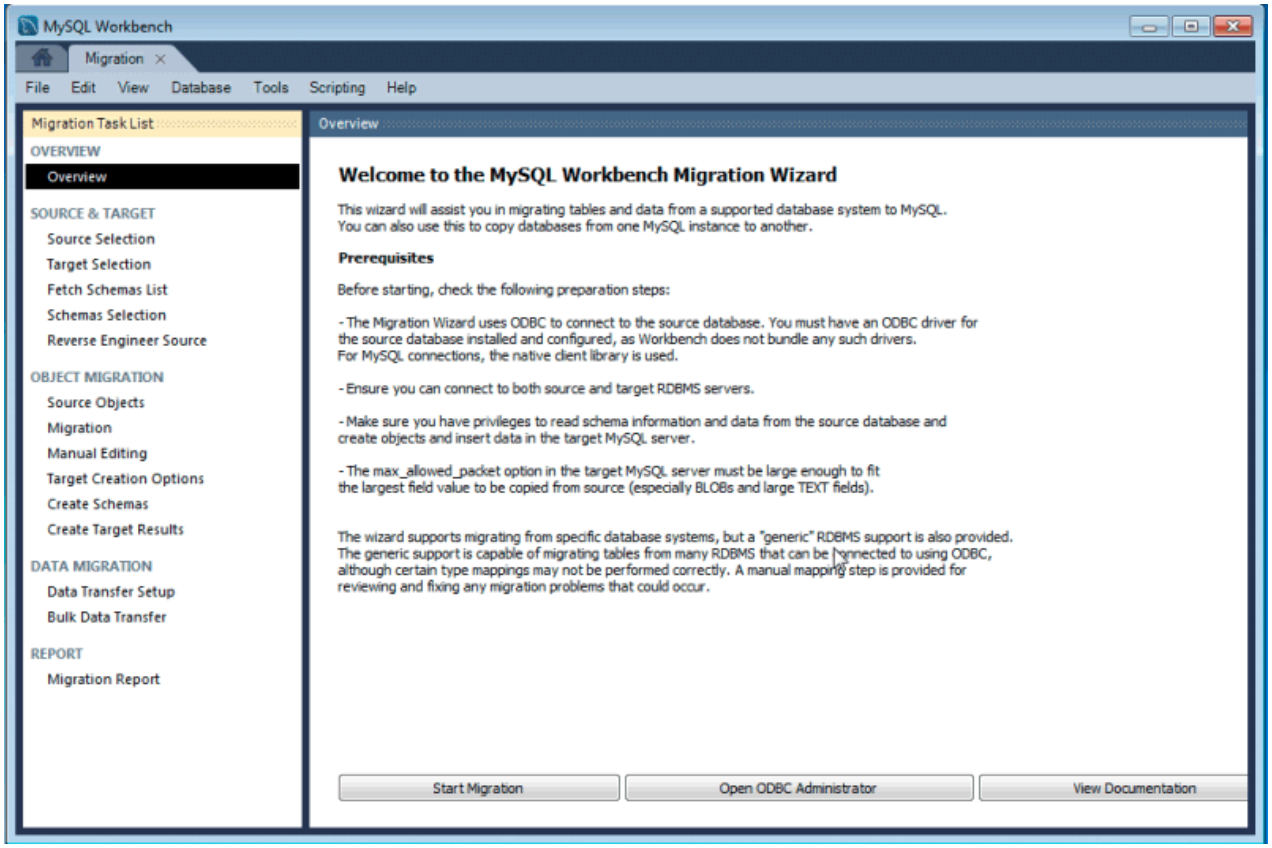
From the main MySQL Workbench screen you can start the Migration Wizard by clicking on the Database Migration launcher in the Workbench Central panel or through Database, Migrate from the main menu.

Figure 10.23 Start the Migration Wizard



A new tab showing the Overview page of the Migration Wizard should appear.

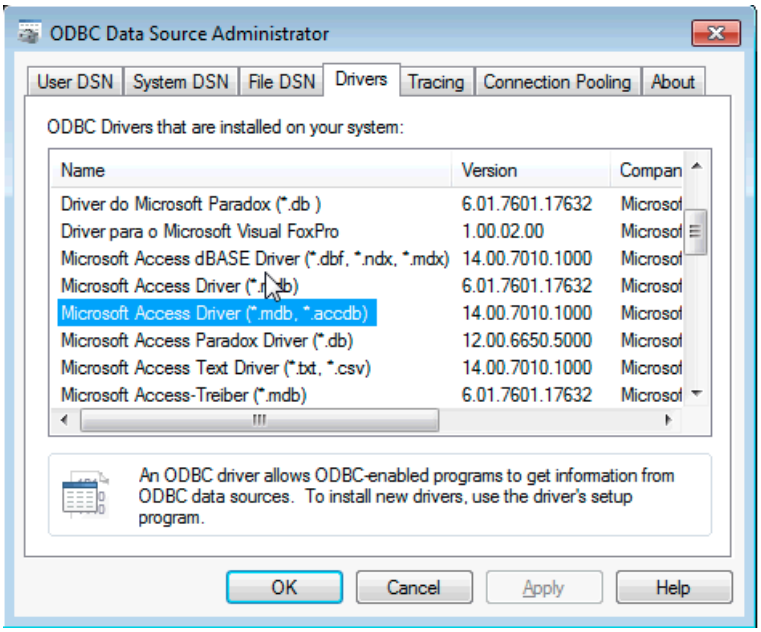
Figure 10.24 Migration Overview Page


MySQL Workbench
Migration
File Edit View Database Tools Scripting Help
Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemas List
Schemas Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Overview
Welcome to the MySQL Workbench Migration Wizard
This wizard will assist you in migrating tables and data from a supported database system to MySQL.
You can also use this to copy databases from one MySQL instance to another.
Prerequisites
Before starting, check the following preparation steps:
- The Migration Wizard uses ODBC to connect to the source database. You must have an ODBC driver for the source database installed and configured, as Workbench does not bundle any such drivers.
For MySQL connections, the native client library is used.
- Ensure you can connect to both source and target RDBMS servers.
- Make sure you have privileges to read schema information and data from the source database and create objects and insert data in the target MySQL server.
- The max_allowed_packet option in the target MySQL server must be large enough to fit the largest field value to be copied from source (especially BLOBs and large TEXT fields).
The wizard supports migrating from specific database systems, but a "generic" RDBMS support is also provided. The generic support is capable of migrating tables from many RDBMS that can be connected to using ODBC, although certain type mappings may not be performed correctly. A manual mapping step is provided for reviewing and fixing any migration problems that could occur.
Start Migration
Open ODBC Administrator
View Documentation

Setting Up ODBC Drivers

To check if you have the ODBC driver installed, click Open ODBC Administrator from the MySQL Workbench migration overview page to open the system ODBC tool. Then, select the **Drivers** tab.

Figure 10.25 Checking the ODBC Drivers for Access Support

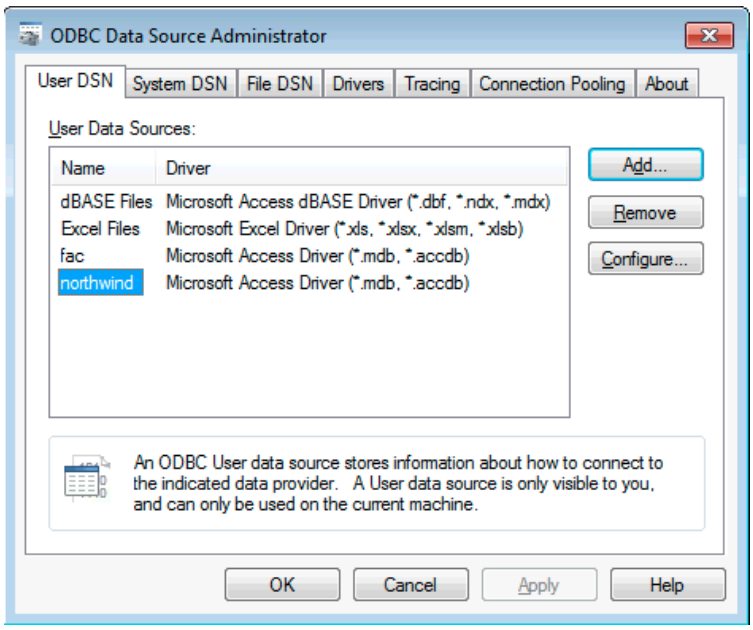


Important

MySQL Workbench has both 32-bit and 64-bit executables. The ODBC drivers you use must be of the same architecture as the MySQL Workbench binaries you are using. Because Office 2007 and older was 32-bit only and even Office 2010 installs as 32-bit by default, you may need to install the 32-bit version of MySQL Workbench to migrate from Access, even if you have a 64-bit machine. If during migration you get an ODBC error about "architecture mismatch between the Driver and Application", you installed the wrong version of MySQL Workbench.

In the **User DSN** tab, click on Add... to create a DSN for your database file. For this example, we created one for the northwind sample database.

Figure 10.26 Adding a New DSN



Setting Up Source Parameters

Click on the Start Migration from the Overview page to advance to the **Source Selection** page. Here you need to provide the information about the Access database you are migrating from, the ODBC driver to use, and the parameters for the Access connection.

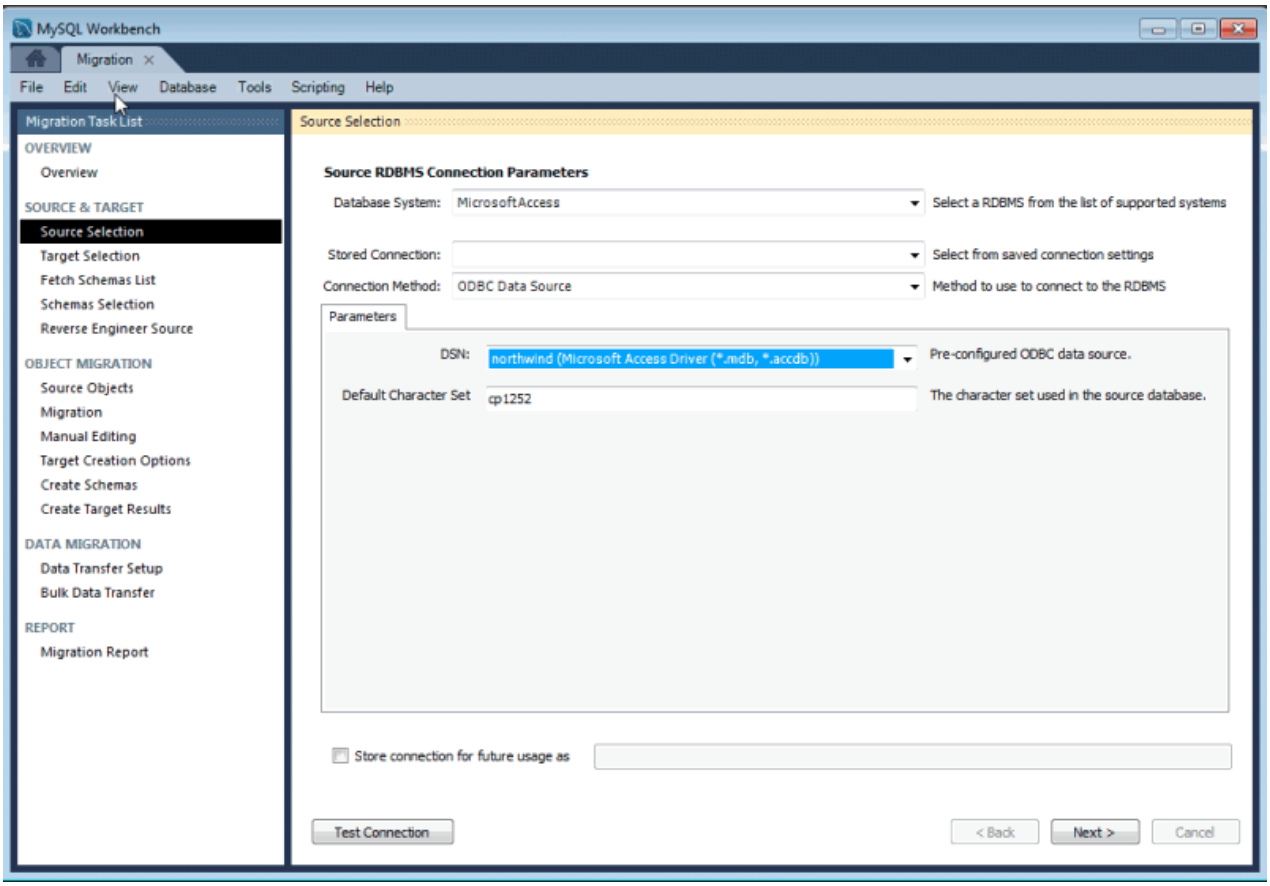
Open the **Database System** combo box for a list of supported RDBMSes, and select **Microsoft Access** from the list. There is another combo box below it named **Stored Connection**. It lists saved connection settings for that RDBMS. You can save connections by marking the checkbox at the bottom of the page, along with a name for the saved connection.

The next combo box selects the **Connection Method**. This time we are going to select *ODBC Data Source* from the list. This allows you to select pre-existing DSNs that you have configured in your system.

The **DSN** dropdown will have all DSNs you have defined in your system. Pick the one you created for the Access database being migrated from the list.

In the **Default Character Set** field you can select the character set of your database. If your Access version uses western/latin characters, you can leave the default *cp1252*. However, if you use a localized version of Access, such as Japanese, you must enter the correct character set used by your edition of Microsoft Office, otherwise the data will be copied incorrectly.

Figure 10.27 Access Source Selection

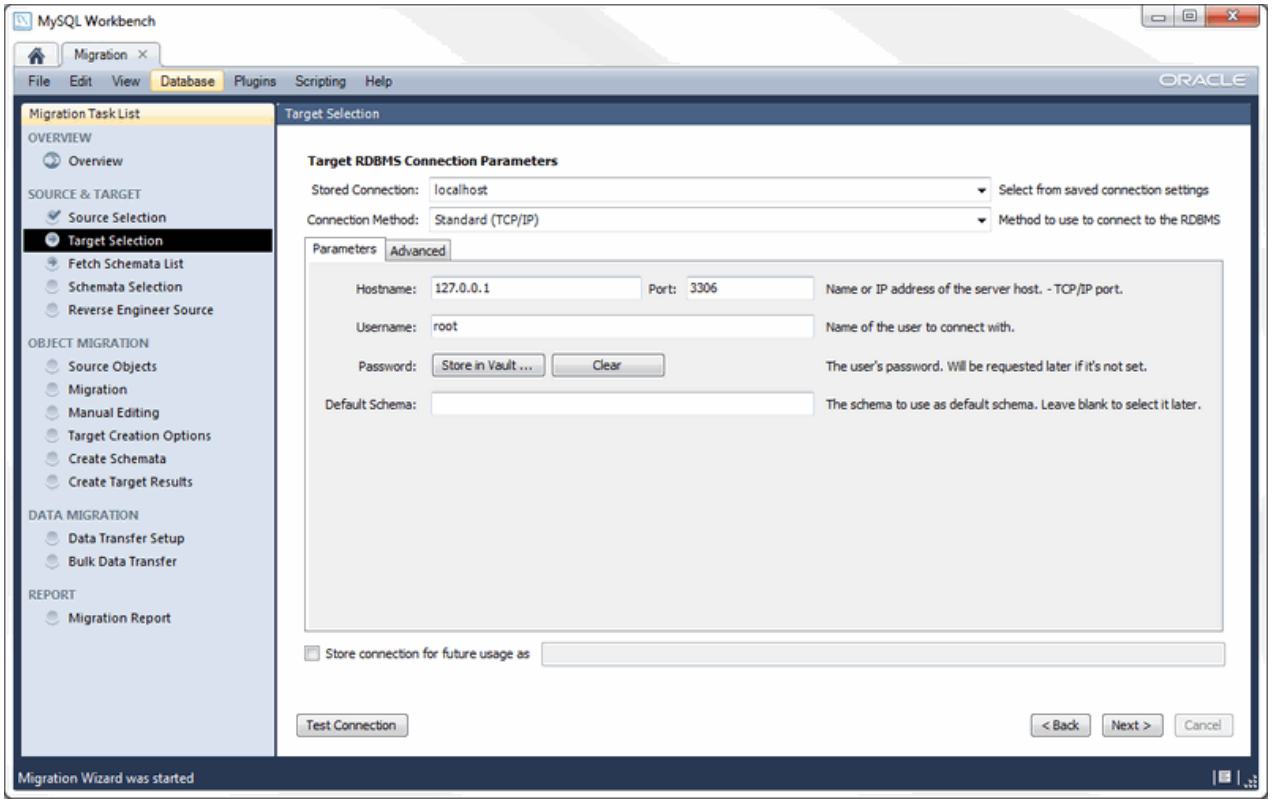


Lastly, click Test Connection to check whether an ODBC connection can be established. If you entered the correct parameters then you should see a message reporting a successful connection attempt.

Setting Up Target Parameters

Next, set up the target (MySQL) database parameters by defining the parameters that connect to your MySQL Server instance. When finished, click Test Connection to verify the connection definition.

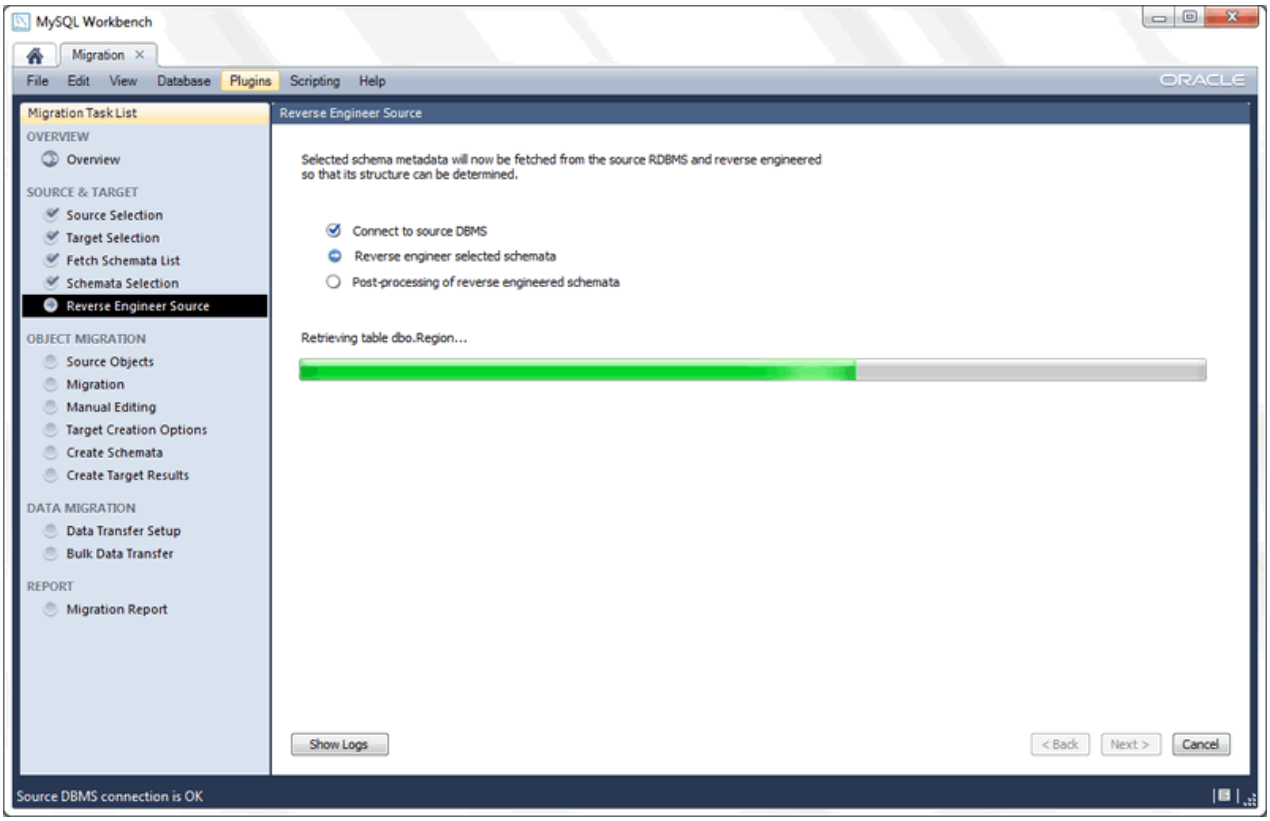
Figure 10.28 Target Database Selection



Select the objects to migrate

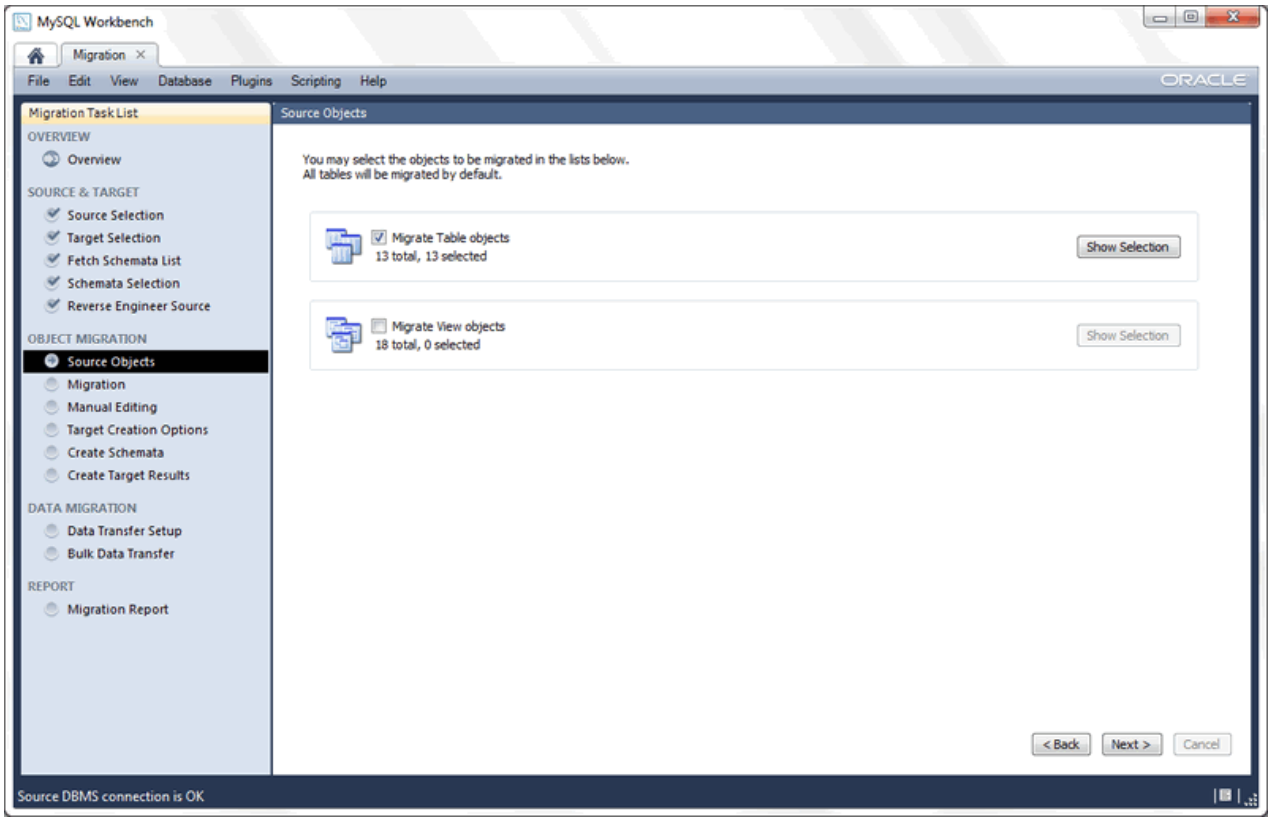
Next, you should see the reverse engineering of the selected database objects progress. At this point, the migration wizard is retrieving relevant information about the involved database objects (such as table names, table columns, primary and foreign keys, indices, triggers, views, and more). You will be presented a page showing the progress as shown below.

Figure 10.29 Reverse Engineer Source



Wait for it to finish and verify that everything went well. Next, the **Source Objects** displays a list with the objects that were retrieved and are available for migration. It will look similar to:

Figure 10.30 Source Objects



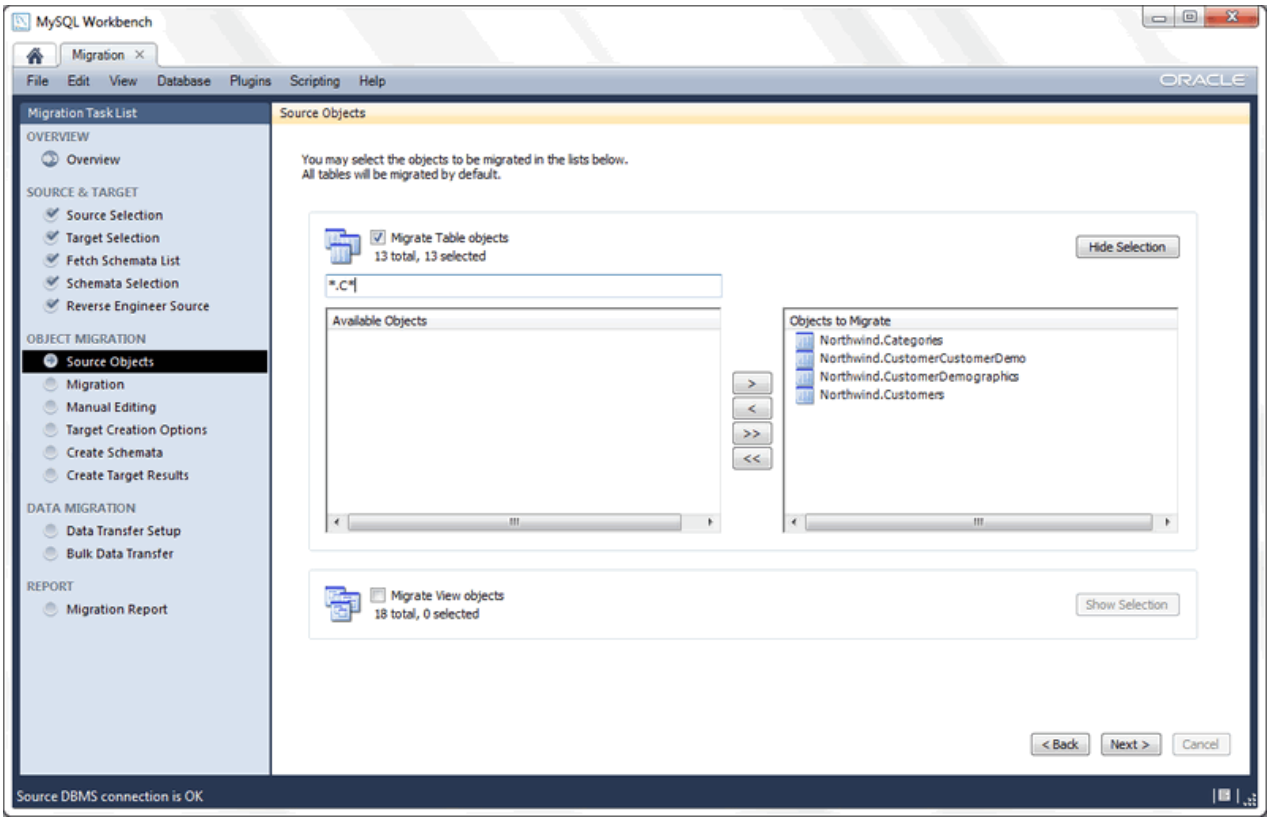
In the above example, the migration wizard discovered table and view objects for our source database. Only the table objects are selected by default for migration.

Note

You can also select the view objects but you must also provide their corresponding MySQL equivalent code later (no automatic migration is available for them) so our example will leave the views unchecked. The same applies for stored procedures, functions and triggers.

Click Show Selection to configure exactly which objects you want to migrate, as seen below:

Figure 10.31 Source Objects Selection

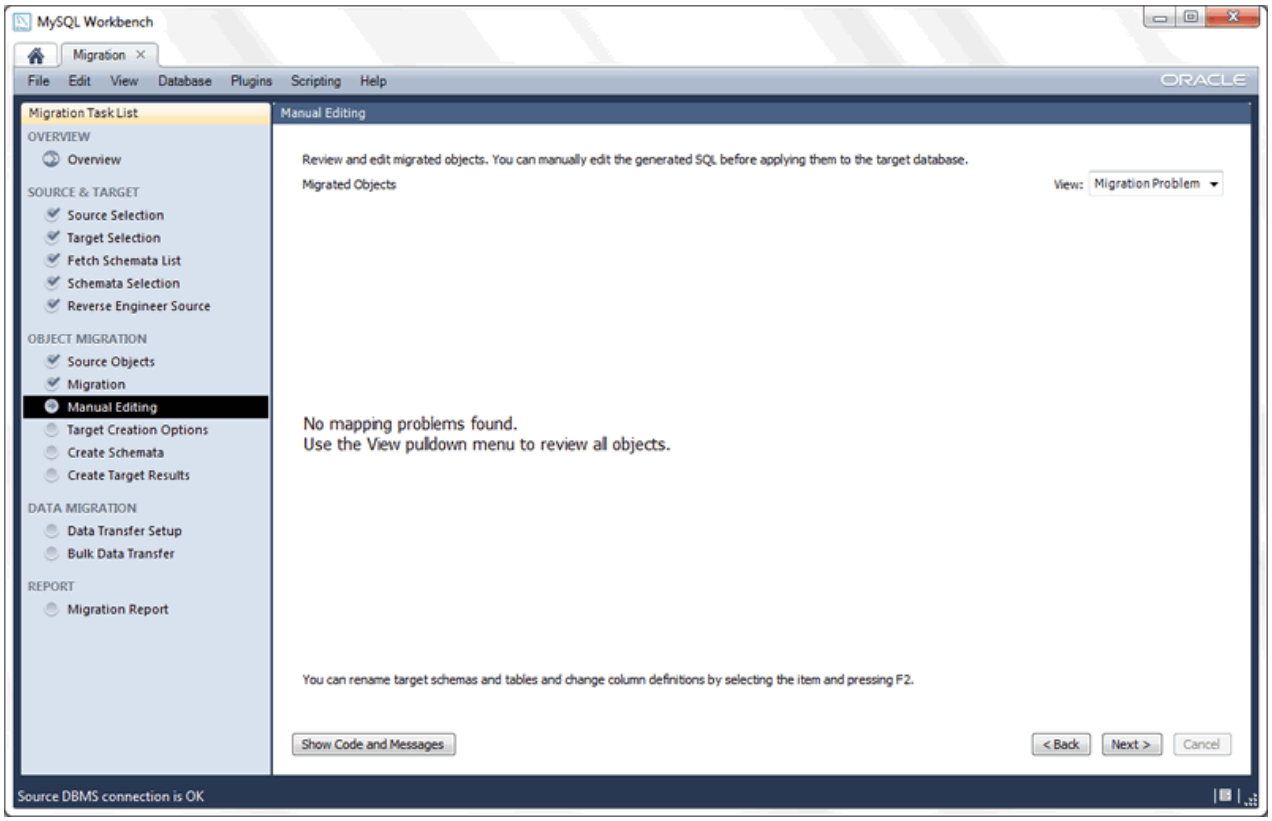


The objects on the right will be migrated. The filter box can filter the list (wildcards are allowed, as demonstrated above). By using the arrow buttons you can filter out the objects that you do not want to migrate. Before continuing, clear the filter text box to check the full list of the selected objects. Our example migrates all of the table objects so all of them are in the **Objects to Migrate** list, and the **Migrate Table Objects** checkbox is checked.

Review the proposed migration

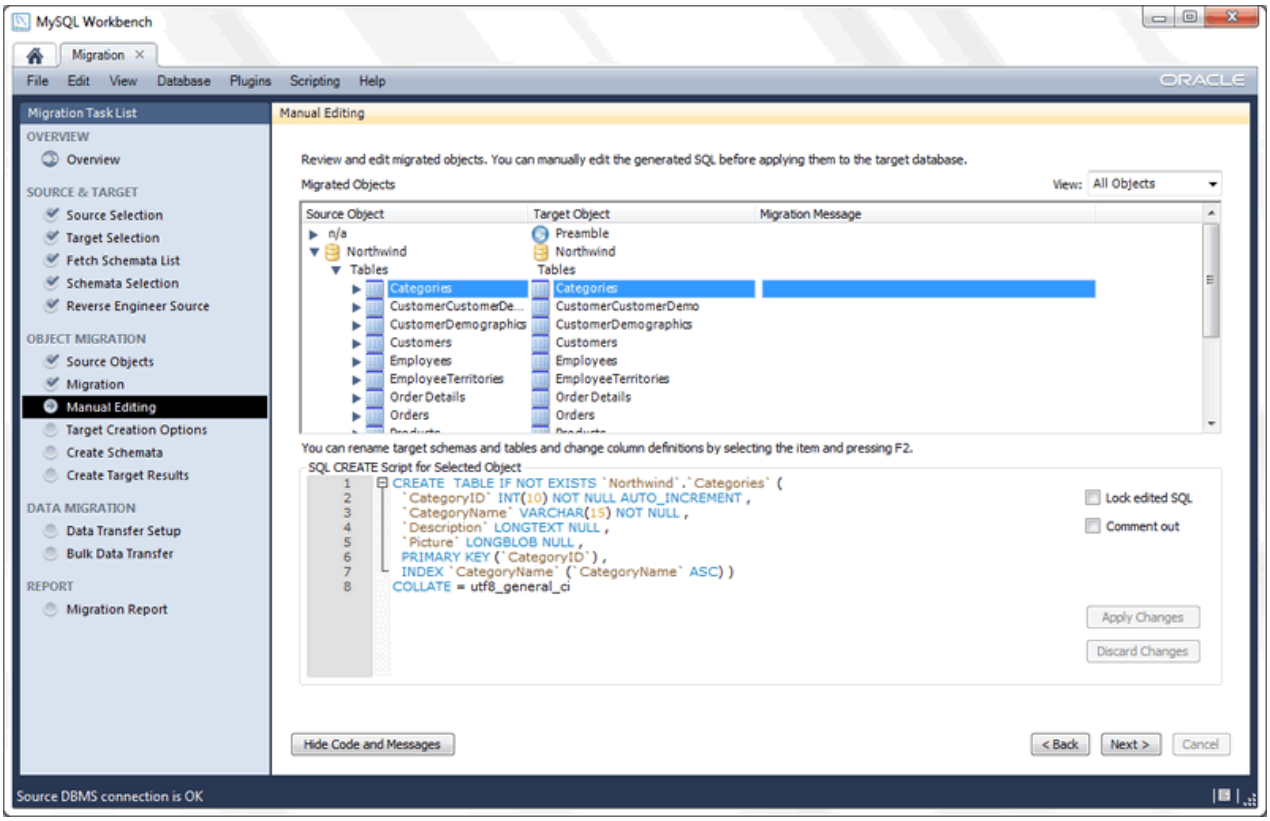
At this point, the migration wizard converts the selected objects into their equivalent objects into the target MySQL server, and it also generates the MySQL code needed to create them. You might have to wait before the **Manual Editing** page is ready, but here is the initial page:

Figure 10.32 Manual Editing: Initial Page



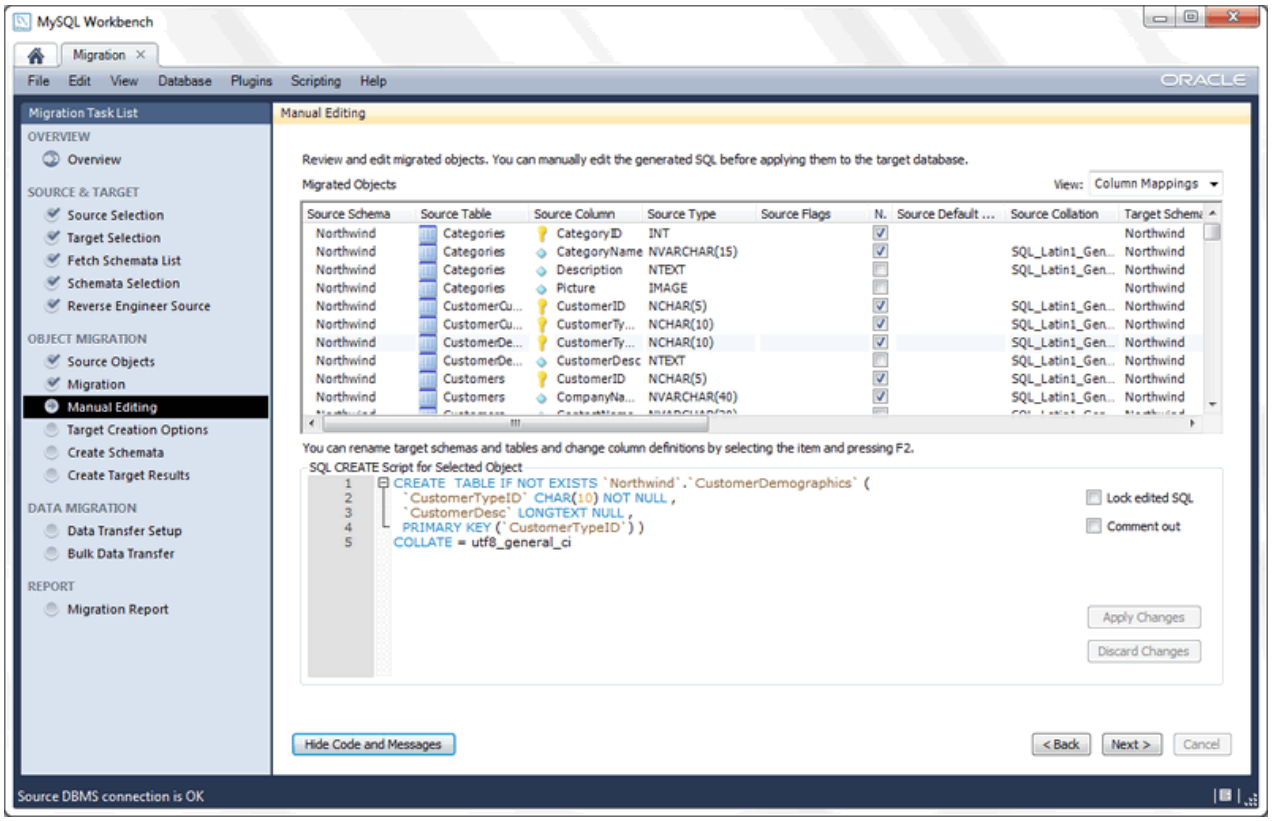
The **View** combo box changes the way the migrated database objects are shown. Click Show Code to view and edit the generated MySQL code that corresponds to the selected object. Additionally, you can double-click on a row in the object tree to edit the object name, or double-click the database row to change its name.

Figure 10.33 Manual Editing: All Objects



The **View** combo box also has a **Column Mappings** option. It shows the table columns and allows you to review and fix the mapping of column types, default values, and other attributes.

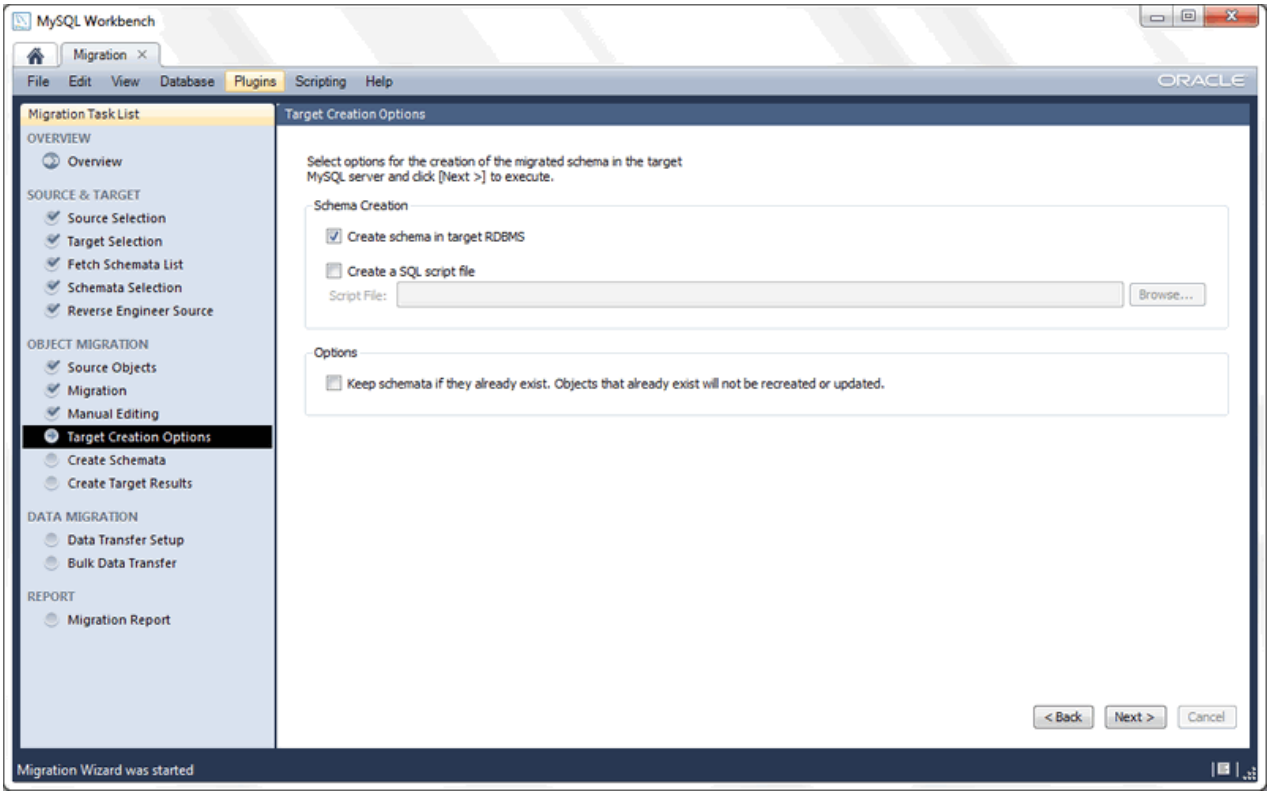
Figure 10.34 Manual Editing: Column Mappings


MySQL Workbench
Migration
File Edit View Database Plugins Scripting Help
ORACLE
Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemata List
Schemata Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemata
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Manual Editing
Review and edit migrated objects. You can manually edit the generated SQL before applying them to the target database.
Migrated Objects
View: Column Mappings
Source Schema | Source Table | Source Column | Source Type | Source Flags | N. | Source Default ... | Source Collation | Target Schema
Northwind | Categories | CategoryID | INT | Northwind
Northwind | Categories | CategoryName | NVARCHAR(15) | SQL_Latin1_Gen... | Northwind
Northwind | Categories | Description | NTEXT | SQL_Latin1_Gen... | Northwind
Northwind | Categories | Picture | IMAGE | Northwind
Northwind | CustomerCu... | CustomerID | NCHAR(5) | SQL_Latin1_Gen... | Northwind
Northwind | CustomerCu... | CustomerTy... | NCHAR(10) | SQL_Latin1_Gen... | Northwind
Northwind | CustomerDe... | CustomerTy... | NCHAR(10) | SQL_Latin1_Gen... | Northwind
Northwind | CustomerDe... | CustomerDesc | NTEXT | SQL_Latin1_Gen... | Northwind
Northwind | Customers | CustomerID | NCHAR(5) | SQL_Latin1_Gen... | Northwind
Northwind | Customers | CompanyNa... | NVARCHAR(40) | SQL_Latin1_Gen... | Northwind
You can rename target schemas and tables and change column definitions by selecting the item and pressing F2.
SQL CREATE Script for Selected Object
CREATE TABLE IF NOT EXISTS `Northwind`.`CustomerDemographics` (
`CustomerTypeID` CHAR(10) NOT NULL ,
`CustomerDesc` LONGTEXT NULL ,
PRIMARY KEY (`CustomerTypeID`))
COLLATE = utf8_general_ci
Lock edited SQL
Comment out
Apply Changes
Discard Changes
Hide Code and Messages
< Back
Next >
Cancel
Source DBMS connection is OK

Create the database objects

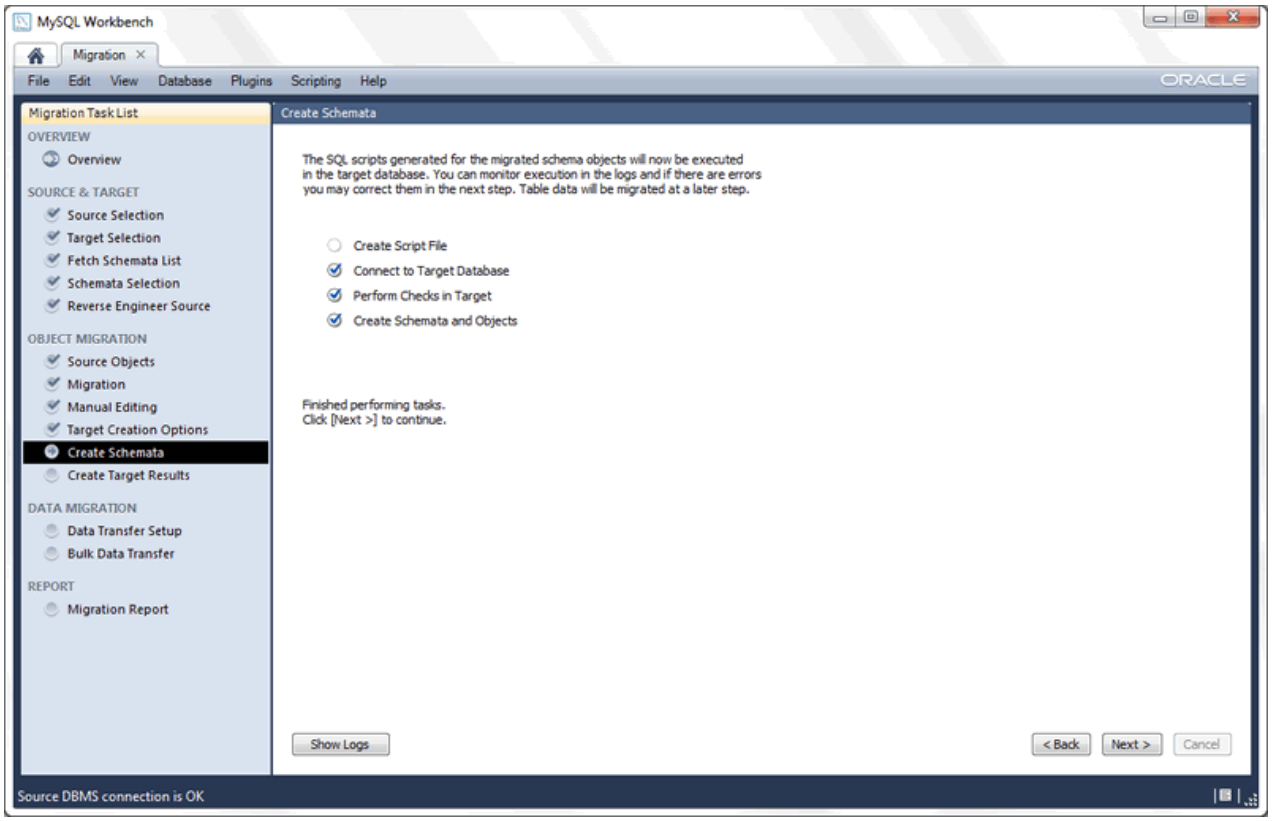
Next is the **Target Creation Options** page:

Figure 10.35 Target Creation Options



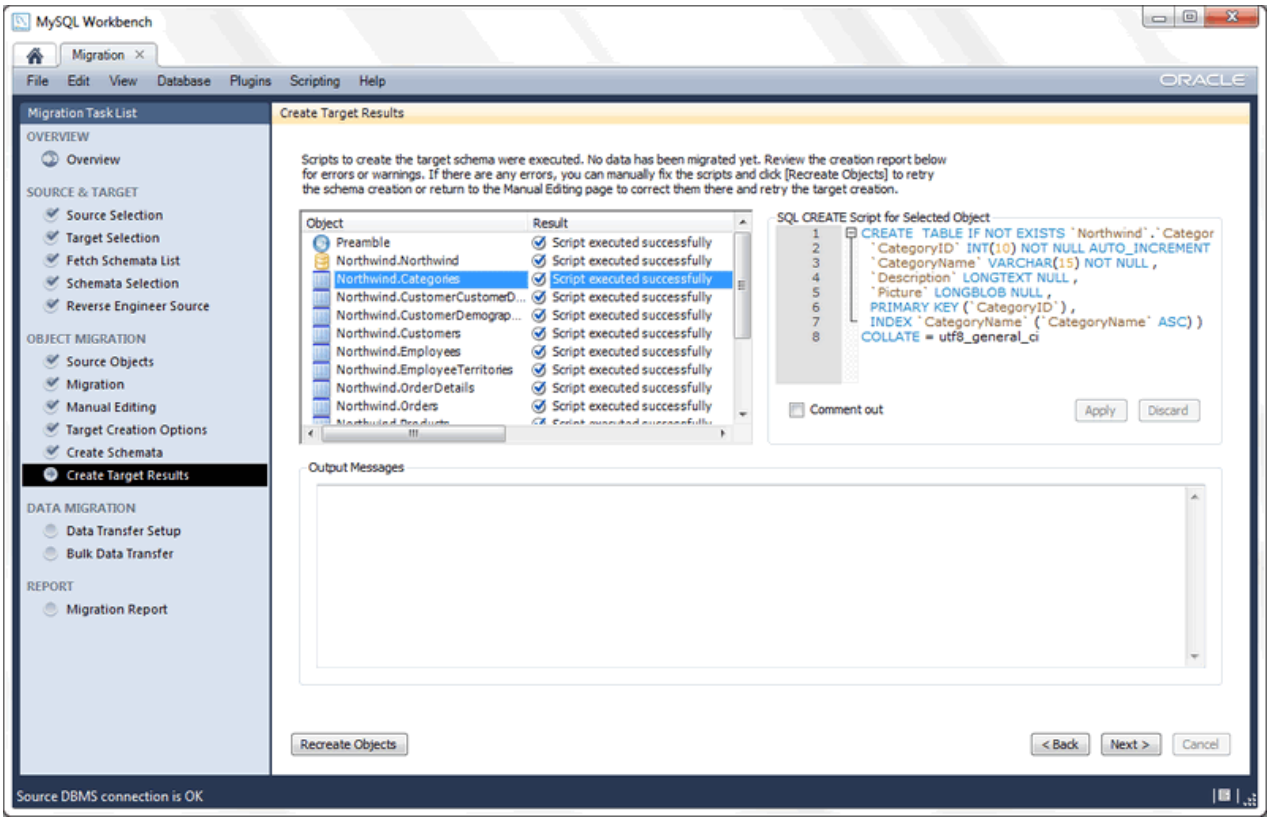
Here are options for executing the generated code in the target RDBMS (your MySQL instance from the second step), or you can dump it to an SQL script file. Leave it as shown above and move to the next page. The migrated SQL code will be executed on the target MySQL server. You can view its progress in the **Create Schemata** page:

Figure 10.36 Create Schemata



Once the creation of the schemata and objects finishes, you can move to the **Create Target Results** page. It presents a list of created objects and includes any generated errors while they were created. It will look similar to:

Figure 10.37 Create Target Results

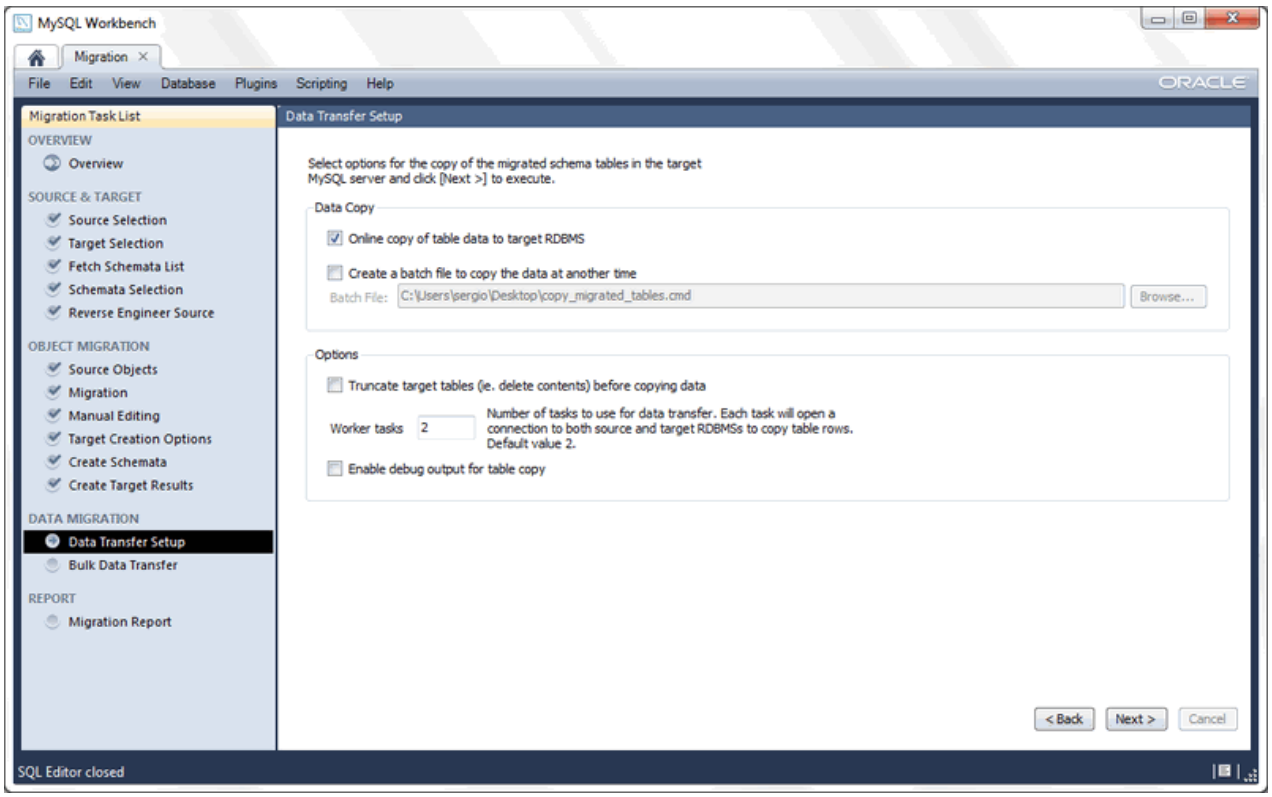


You can edit the migration code using the code box to the right, and save your changes by clicking Apply. If edits were made, you still need to recreate the objects with the modified code in order to perform the changes. This is done by clicking Recreate Objects. In this tutorial we are not changing anything, so leave the code as it is, and continue on to the **Data Transfer Setup** page.

Transfer the data to the MySQL database

The next step transfers data from the source Access database into your newly created target MySQL database. The Data Transfer Setup page allows you to configure this process.

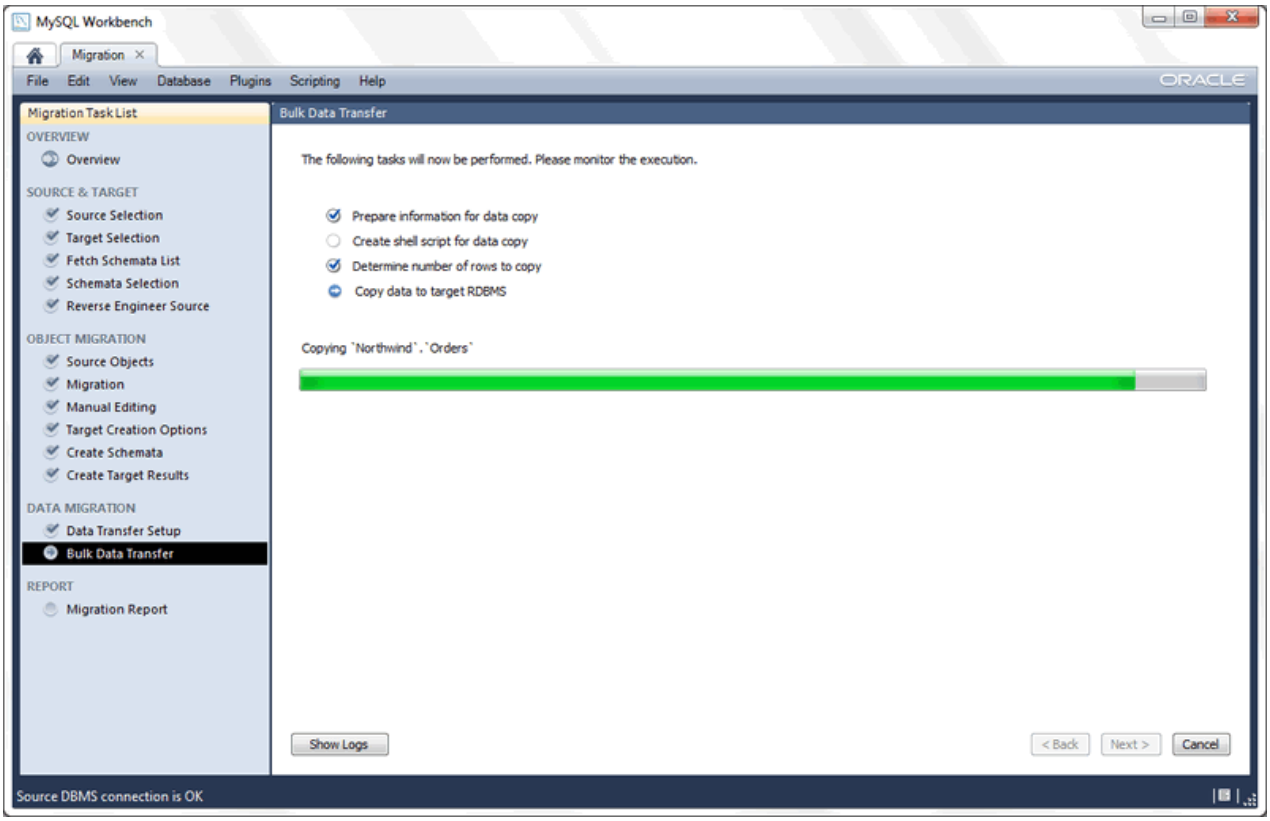
Figure 10.38 Data Transfer Setup


MySQL Workbench
Migration
File Edit View Database Plugins Scripting Help
ORACLE
Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemata List
Schemata Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemata
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Data Transfer Setup
Select options for the copy of the migrated schema tables in the target MySQL server and click [Next >] to execute.
Data Copy
Online copy of table data to target RDBMS
Create a batch file to copy the data at another time
Batch File: C:\Users\sergio\Desktop\copy_migrated_tables.cmd
Browse...
Options
Truncate target tables (ie. delete contents) before copying data
Worker tasks 2
Number of tasks to use for data transfer. Each task will open a connection to both source and target RDBMSs to copy table rows. Default value 2.
Enable debug output for table copy
< Back
Next >
Cancel
SQL Editor closed

There are two sets of options here. The first allows you to perform a live transference and/or to dump the data into a batch file that you can execute later. The other set of options allows you to alter this process.

This tutorial uses the default values for the options in this page as shown in the above screenshot. Next, the data is transferred. At this point the corresponding progress page will look familiar:

Figure 10.39 Bulk Data Transfer

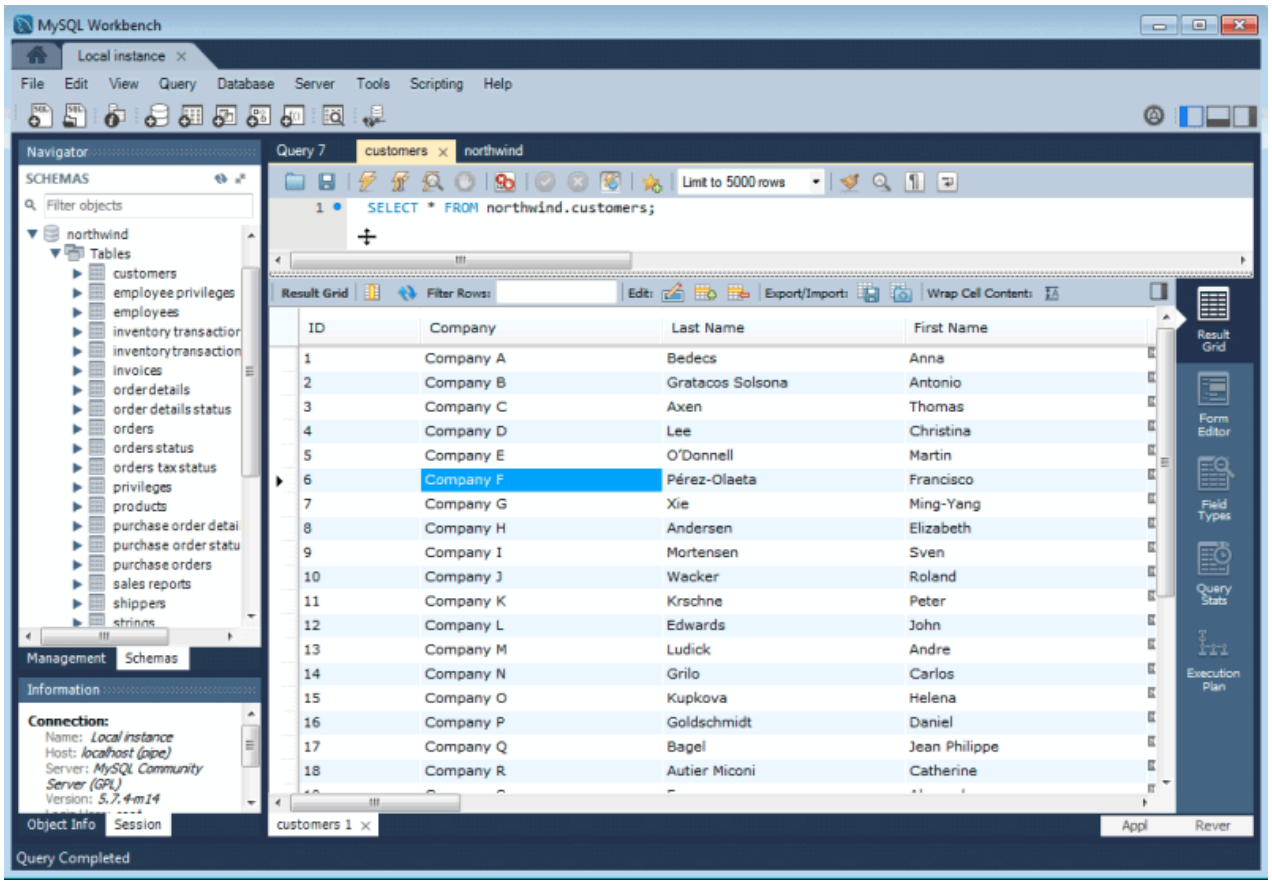


Once it finishes, move to the next page. You will be presented a report page summarizing the whole process. Now, review and click **Finish** to close the wizard.

Verification

Now that the Northwind database was successfully migrated, next we will view the results. Open an SQL Editor that is associated with your MySQL Server instance, and then query the Northwind database. You can try something like "SELECT * FROM Northwind.customers":

Figure 10.40 Verify Your Results



10.5 Microsoft SQL Server migration

The MySQL Workbench Migration Wizard is tested against the following Microsoft SQL Server versions: 2000, 2005, 2008, and 2012.

10.5.1 Preparations

To be able to migrate from Microsoft SQL Server, ensure the following:

- The source SQL Server instance is running, and accepts TCP connections.
- You know the IP and port of the source SQL server instance. If you will be migrating using a Microsoft ODBC driver for SQL Server (the default in Windows), you will need to know the host and the name of the SQL Server instance.
- Make sure that the SQL Server is reachable from where you will be running MySQL Workbench. More specifically, check the firewall settings.
- Make sure that the user account has proper privileges to the database that will be migrated.

10.5.2 Drivers

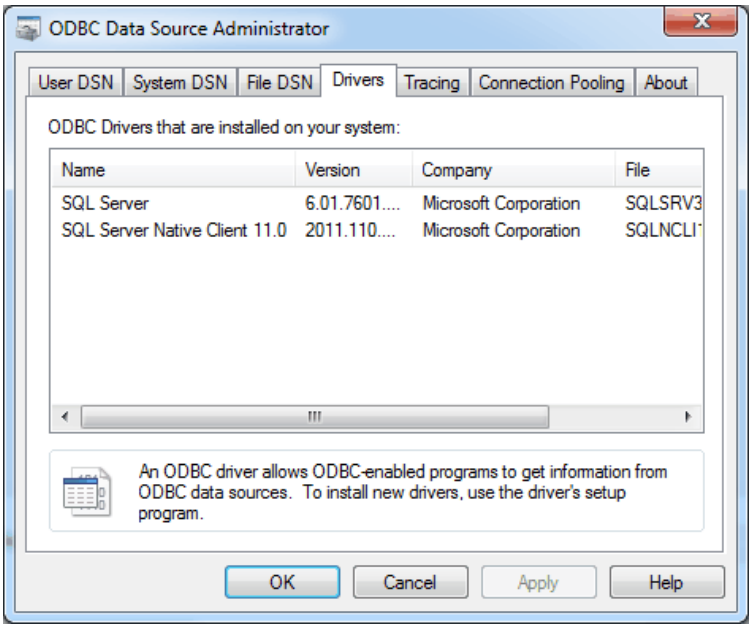
Microsoft Windows does not require additional drivers to be installed and configured, but Linux (and OS X) do. The following sections include specific instructions for each type of system.

10.5.2.1 Windows

Microsoft Windows XP and newer includes at least one ODBC driver for Microsoft SQL Server, so additional actions are likely not required on your system. Multiple SQL Server driver options exist, as described below.

You can check your ODBC driver information by starting the Windows ODBC Data Source Administrator that is linked from the MySQL Workbench migration wizard's home page. Alternatively, open a Windows terminal and execute `odbcad32.exe`. Open the **Drivers** tab to see something similar to:

Figure 10.41 Windows ODBC Data Source Administrator: SQL Server Drivers



Common ODBC drivers available on Windows are:

- **SQL Driver**: preinstalled on Windows, but is limited to the functionality provided by SQL Server 2000. It functions okay if your database does not use features and data types introduced after SQL Server 2000, so it should be enough for you if your database does not make use of the new features and data types introduced after this SQL Server version.
- **SQL Server Native Client XX.X**: if you have a SQL Server instance on the same machine as MySQL Workbench, then you will also have this additional driver. This comes with SQL Server and fully supports the companion SQL Server version. If this is not on your system then you can download and install this it from Microsoft. For example, download the Microsoft SQL Server 2014 Feature Pack to install the Native Client that supports SQL Server 2014 and earlier.

Note

XX.X represents the major version number for SQL Server, so an actual name might be "SQL Server Native Client 11.0".

Decide which driver you want to use, and remember its name as shown in the ODBC Data Source Administrator. This specific name is used in MySQL Workbench to connect your SQL Server instance.

Jump to the documentation titled Section 10.5.3, “Connection Setup”.

10.5.2.2 Linux

Setting up drivers on Linux.

FreeTDS

FreeTDS version 0.92 or greater is required. Many distributions ship older versions of FreeTDS, so it may need to be installed separately. Additionally, the FreeTDS version provided by distributions may also be compiled for the wrong ODBC library (usually to unixODBC instead of iODBC, which MySQL Workbench uses). Because of that, you will probably need to build this library yourself.

A script is provided to compile FreeTDS using the options required for MySQL Workbench. You can find it at `/usr/share/mysql-workbench/extras/build_freetds.sh` on Linux or `MySQLWorkbench.app/Contents/SharedSupport/build_freetds.sh` on OS X. To use it, follow these steps:

Using FreeTDS with iODBC

When compiling FreeTDS for use with iODBC (the default with the official binaries), it must be compiled with the `--enable-odbc-wide` command line. Failing to do so will result in crashes and other unpredictable errors. The provided `build_freetds.sh` script does this for you.

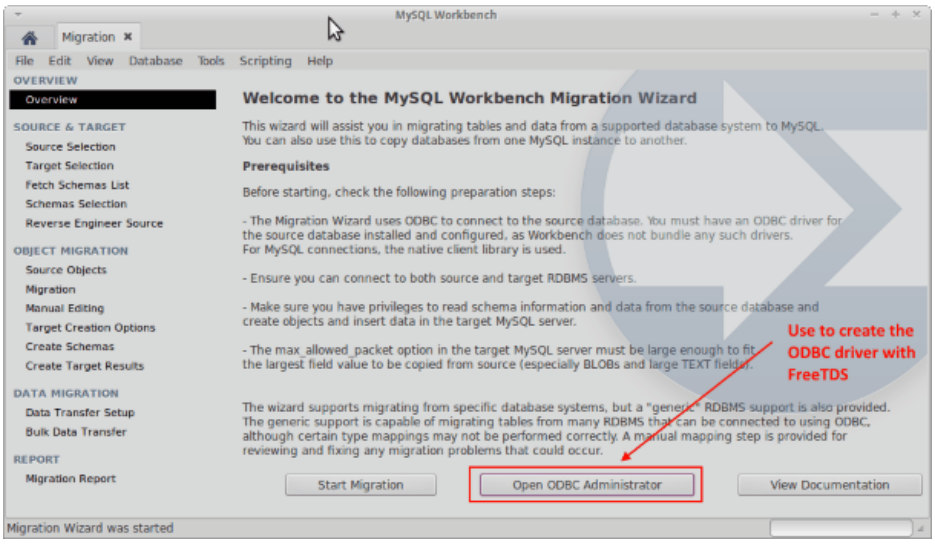
1. For compiling, make sure you have the iODBC headers installed. For Linux, the name depends on your system's package manager but common names are `libiodbc-devel` (RPM based systems) or `libiodbc2-dev` (Debian based systems). For OS X, the headers come with the system and no additional action is required for this step.

   Note

   If you are using Oracle Enterprise Linux, RedHat, CentOS, and similar, you must have the EPEL repository set up in yum for it to find the `libiodbc-devel` package. For additional information about this step, see Installing Oracle Enterprise Linux and similar.

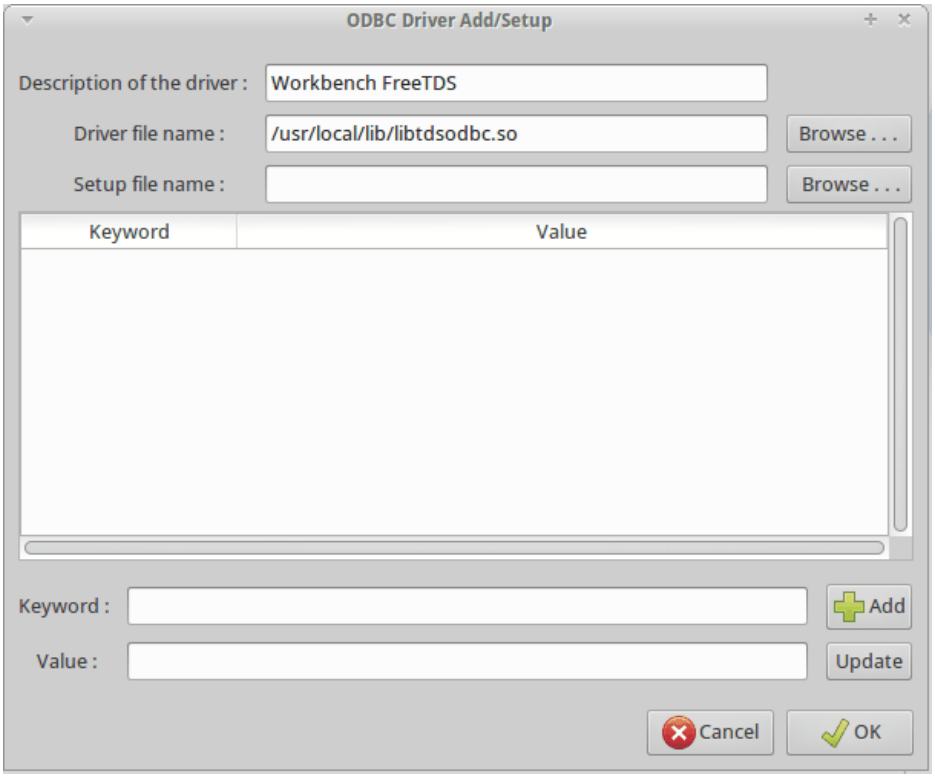
2. `mkdir ~/freetds` to create a directory - within the users home directory.
3. Copy the `build_freetds.sh` script to `~/freetds`
4. Get the latest FreeTDS sources from ftp://ftp.freetds.org/pub/freetds/ and place the `.tar.gz` source file into the `~/freetds` directory. Make sure to get FreeTDS version 0.92 or newer.
5. `cd ~/freetds`
6. Execute `build_freetds.sh`
7. After compilation is done, install it using `make install` from the path given by the script.
8. Install the driver using ODBC Administrator so that the ODBC subsystem recognizes it. Open ODBC Administrator from the migration tab in MySQL Workbench.

Figure 10.42 Open the ODBC Administrator


MySQL Workbench
Migration
File Edit View Database Tools Scripting Help
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemas List
Schemas Selection
Reverse Engineer Source
OBJECT MIGRATION
Source Objects
Migration
Manual Editing
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Welcome to the MySQL Workbench Migration Wizard
This wizard will assist you in migrating tables and data from a supported database system to MySQL.
You can also use this to copy databases from one MySQL instance to another.
Prerequisites
Before starting, check the following preparation steps:
- The Migration Wizard uses ODBC to connect to the source database. You must have an ODBC driver for the source database installed and configured, as Workbench does not bundle any such drivers.
For MySQL connections, the native client library is used.
- Ensure you can connect to both source and target RDBMS servers.
- Make sure you have privileges to read schema information and data from the source database and create objects and insert data in the target MySQL server.
- The max_allowed_packet option in the target MySQL server must be large enough to fit the largest field value to be copied from source (especially BLOBs and large TEXT fields).
Use to create the ODBC driver with FreeTDS
The wizard supports migrating from specific database systems, but a "generic" RDBMS support is also provided. The generic support is capable of migrating tables from many RDBMS that can be connected to using ODBC, although certain type mappings may not be performed correctly. A manual mapping step is provided for reviewing and fixing any migration problems that could occur.
Start Migration
Open ODBC Administrator
View Documentation
Migration Wizard was started

The name of the driver file is `libtdsodbc.so` and it is located in `/usr/lib` or `/usr/local/lib`. For example, under the **ODBC Drivers** tab click Add Driver and fill out the description (name) and path to the driver file. Remember the name you define here as it will be needed later on. Save the driver.

Figure 10.43 ODBC Driver Add/Setup



Note

Only the driver file name is required, while the setup file name can remain undefined.

9. Close the ODBC Administrator and click Start Migration. For information about making a Microsoft SQL Server connection using the MySQL Workbench migration wizard, see Section 10.5.3.2, “Linux”.

10.5.2.3 OS X

See the FreeTDS setup notes for Linux, Section 10.5.2.2, “Linux”.

10.5.3 Connection Setup

This section focuses on creating a connection to the source Microsoft SQL Server, because creating a MySQL connection is a standard operation.

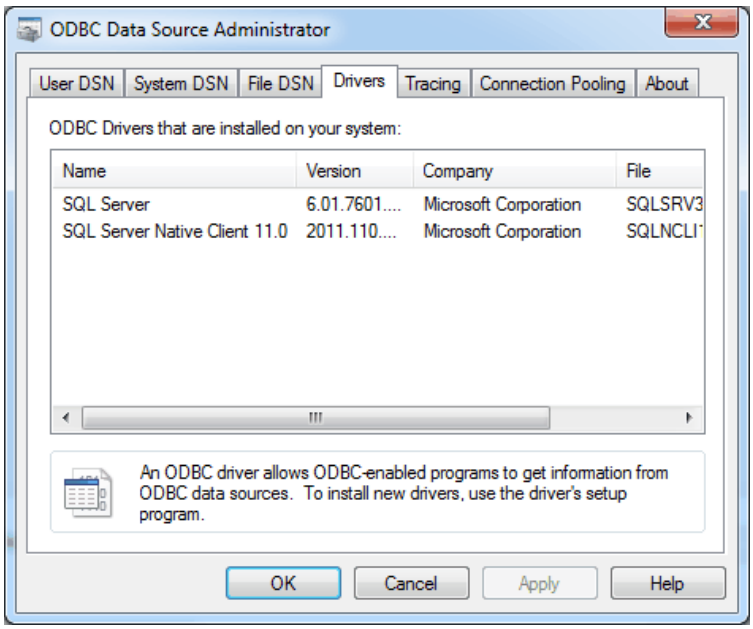
Note

Prerequisite: that you already installed and configured the required Microsoft SQL Server driver on the system running MySQL Workbench.

10.5.3.1 Windows

Select Microsoft SQL Server as the database system and fill out the remaining options as described below.

Figure 10.44 SQL Server Connection Parameters Example on Windows



- **Database System**: Microsoft SQL Server
- **Connection Method**: choose ODBC (native) to use the native ODBC driver that is provided by Microsoft. Alternatives include "ODBC data sources" and "ODBC FreeTDS". FreeTDS is a popular open source driver for SQL Server and Sybase.

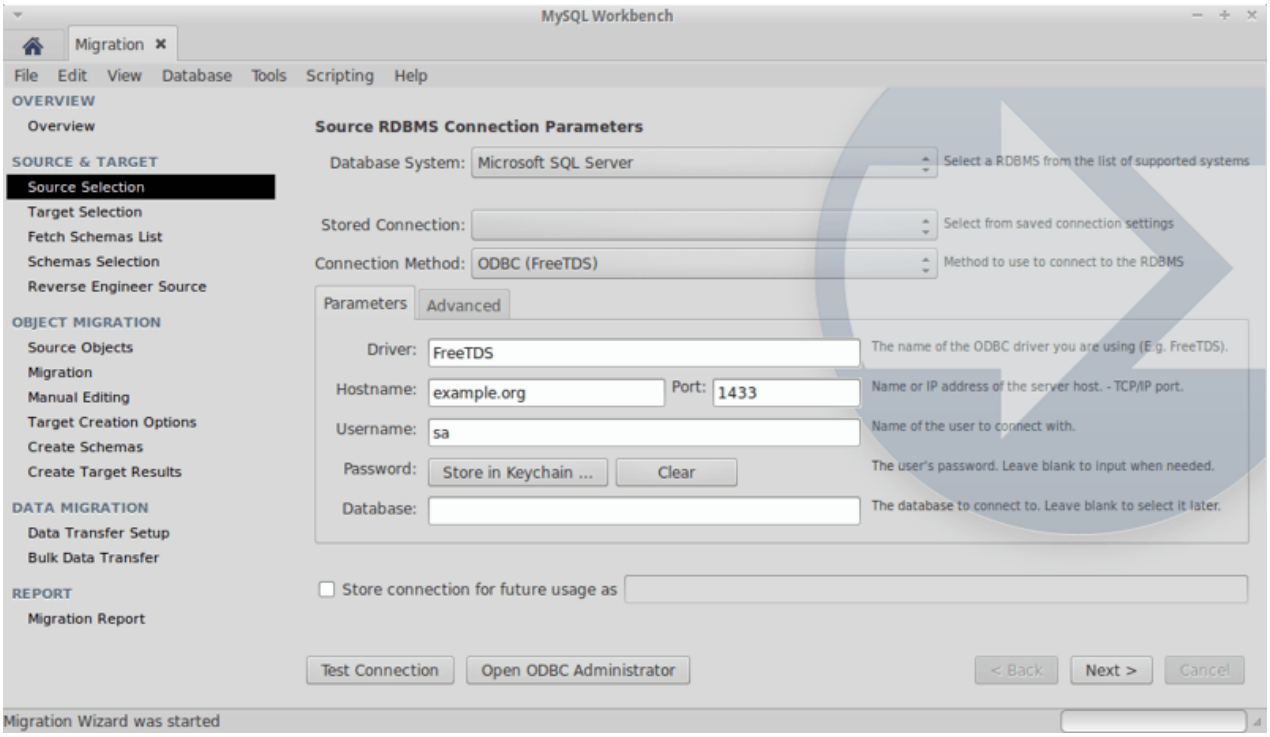
- **Driver**: use the SQL Server driver name, as described in the documentation titled Section 10.5.2.1, “Windows”. Typically this will be "SQL Server" or a versioned client, such as "SQL Server Native Client 11.0".
- **Server**: the address and optionally instance name of the SQL server, such as "example.com" or "example.org\SQLEXPRESS".
- **Username**: the user name on the SQL Server, with "sa" being a commonly used name.
- **Password**: optionally enter a password to save locally, or leave it blank to enter the password when the SQL Server connection is made later on in the process.
- **Database**: optionally enter a database name. Leave it blank to select a database name after the MySQL Workbench wizard fetches the available databases.
- **Store connection for future**: optionally store the connection details locally for future use by checking this box and entering a name for the connection.
- **Advanced**: optionally enter additional options.

Click Test Connection to confirm that the parameters are correct before moving on.

10.5.3.2 Linux

Select Microsoft SQL Server as the source database system and fill out the remaining options as described below.

Figure 10.45 SQL Server Connection Parameters Example on Linux



- **Database System**: Microsoft SQL Server
- **Connection Method**: choose ODBC (FreeTDS) to use the local FreeTDS that was installed in an earlier step. For additional information about how to install a FreeTDS driver on Linux that will work with the MySQL Workbench migration wizard, see Section 10.5.2.2, “Linux”.

Alternatively, choose ODBC Data Source (FreeTDS) if you defined a DSN when creating the SQL Server driver. The available pre-configured DSN options will be available to choose from.

- **Driver**: The name of the driver that you created with the ODBC Administrator, as described in the documentation titled Section 10.5.2.2, “Linux”.

  An example name might be "Workbench FreeTDS", or "FreeTDS", but it is the name you defined in an earlier step, so it may or may not be "FreeTDS". Use the ODBC Administrator to find the correct driver name, as otherwise the connection will fail.

- **Hostname**: the address and instance name of the SQL server, such as "example.org".
- **Port**: the port number. Port number 1433 is commonly used for MySQL server.
- **Username**: the user name on the SQL server, with "sa" being a commonly used name.
- **Password**: optionally enter a password to save locally, or leave it blank to enter the password when the SQL Server connection is made later on in the process.
- **Database**: optionally enter a database name. Leave it blank to select a database name after the MySQL Workbench wizard fetches the available databases.
- **Store connection for future**: optionally store the connection details locally for future use by checking this box and entering a name for the connection.
- **Advanced**: Deselect the **Driver sends Unicode data as UTF-8** option to use UCS-2.

Note

If your MSSQL server connection succeeded but the data import failed, it could be because this setting was enabled.

Click Test Connection to confirm that the parameters are correct before moving on.

10.5.3.3 OS X

Connection parameters are similar to Linux, see Section 10.5.3.2, “Linux”.

10.5.4 Microsoft SQL Server Type Mapping

Table 10.2 Type mapping

Source Type	MySQL Type	Comment
INT	INT	
TINYINT	TINYINT	UNSIGNED flag set in MySQL
SMALLINT	SMALLINT	
BIGINT	BIGINT	
BIT	TINYINT(1)	
FLOAT	FLOAT	Precision value is used for storage size in both
REAL	FLOAT	
NUMERIC	DECIMAL	
DECIMAL	DECIMAL	
MONEY	DECIMAL	

Source Type	MySQL Type	Comment
SMALLMONEY	DECIMAL	
CHAR	CHAR/LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have CHAR columns with a length up to 255 characters. Anything larger is migrated as LONGTEXT
NCHAR	CHAR/LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types. In MySQL, character set of strings depend on the column character set instead of the datatype.
VARCHAR	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types.
NVARCHAR	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types. In MySQL, character set of strings depend on the column character set instead of the datatype.
DATE	DATE	
DATETIME	DATETIME	
DATETIME2	DATETIME	Date range in MySQL is '1000-01-01 00:00:00.000000' to '9999-12-31 23:59:59.999999'. Note: fractional second values are only stored as of MySQL Server 5.6.4
SMALLDATETIME	DATETIME	
DATETIMEOFFSET	DATETIME	
TIME	TIME	
TIMESTAMP	TIMESTAMP	
ROWVERSION	TIMESTAMP	
BINARY	BINARY/MEDIUMBLOB/ LONGBLOB	Depending on its length
VARBINARY	VARBINARY/ MEDIUMBLOB/ LONGBLOB	Depending on its length
TEXT	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length
NTEXT	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length

Source Type	MySQL Type	Comment
IMAGE	TINYBLOB/ MEDIUMBLOB/ LONGBLOB	Depending on its length
SQL_VARIANT	not migrated	There is not specific support for this datatype.
TABLE	not migrated	There is not specific support for this datatype.
HIERARCHYID	not migrated	There is not specific support for this datatype.
UNIQUEIDENTIFIER	VARCHAR(64)	A unique flag set in MySQL. There is not specific support for inserting unique identifier values.
SYSNAME	VARCHAR(160)	
XML	TEXT	

10.6 PostgreSQL migration

10.6.1 Preparations

Before proceeding, you will need the following:

- Follow the installation guide for installing iODBC on your system. For more information, see Section 10.1, “General installation requirements”.
- Access to a running PostgreSQL instance with privileges to the database you want to migrate, otherwise known as the "source database." The Migration Wizard officially supports PostgreSQL 8.0 and above, although older versions may work.
- Access to a running MySQL Server instance with privileges to the database you want to migrate. The Migration Wizard officially supports MySQL 5.0 and above.

10.6.2 Drivers

10.6.2.1 Microsoft Windows

Download and install the MSI package for psqlODBC. Choose the newest file from http://www.postgresql.org/ftp/odbc/versions/msi/, which will be at the bottom of the downloads page. This will install psqlODBC on your system and allow you to migrate from Postgresql to MySQL using MySQL Workbench.

10.6.2.2 Linux

After installing iODBC, proceed to install the PostgreSQL ODBC drivers.

Download the psqlODBC source tarball file from http://www.postgresql.org/ftp/odbc/versions/src/. Use the latest version available for download, which will be at the bottom of the downloads page. The file will look similar to `psqlodbc-09.03.0400.tar.gz`. Extract this tarball to a temporary location, open a terminal, and cd into that directory. The installation process is:

```
shell> cd the/src/directory
shell> ./configure --with-iodbc --enable-pthreads
shell> make
shell> sudo make install
```

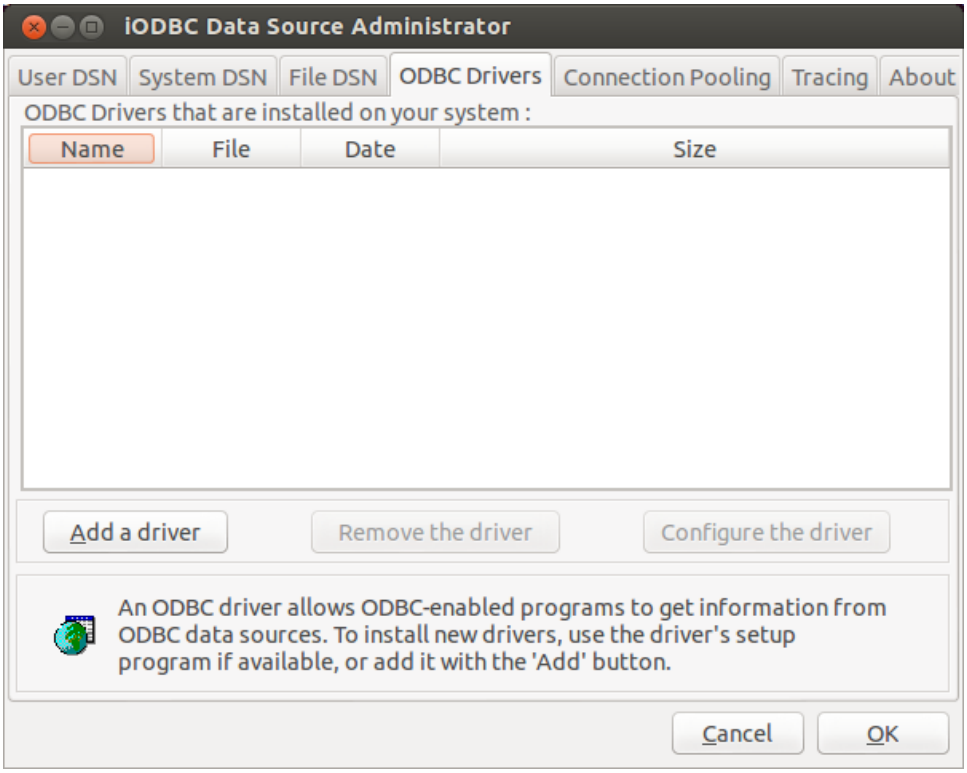
Verify the installation by confirming that the file `psqlodbcw.so` is in the `/usr/local/lib` directory.

Next, you must register your new ODBC Driver.

Open the iODBC Data Source Administrator application by either executing `iodbcadm-gtk` in the command-line, or by launching it from the **Overview** page of the MySQL Workbench Migration Wizard by clicking the Open ODBC Administrator button.

Go to the **ODBC Drivers** tab in the iODBC Data Source Administrator. It should look similar to:

Figure 10.46 The iODBC Data Source Administrator



Click Add a driver then fill out the form with the following values:

- **Description of the driver**: psqlODBC
- **Driver file name**: `/usr/local/lib/psqlodbcw.so`
- **Setup file name**: No value is needed here

And lastly, clicking OK will complete the `psqlODBC` driver registration.

10.6.2.3 OS X

To compile `psqlODBC` on OS X, you will need to have Xcode and its "Command Line Tools" component installed on your system, as this includes the required `gcc` compiler. Xcode is free, and available from the AppStore. And after installing Xcode, open it and go to Preferences, **Downloads**, **Components**, and then install the "Command Line Tools" component.

Download the psqlODBC source tarball file from http://www.postgresql.org/ftp/odbc/versions/src/. Use the latest version available for download, which will be at the bottom of the downloads page. The file will look similar to `psqlodbc-09.03.0400.tar.gz`. Extract this tarball to a temporary location, open a terminal, and cd into that directory. The installation process is:

```
shell> cd the/src/directory
shell> ./configure --with-iodbc --enable-pthreads
```

```
shell> CFLAGS="-arch i386 -arch x86_64" make
shell> sudo make install
```

10.6.3 Connection Setup

After loading the Migration Wizard, click on the Start Migration button in the **Overview** page to begin the migration process. You will first connect to the source PostgreSQL database. Here you will provide the information about the PostgreSQL RDBMS that you are migrating from, the ODBC driver that will be used for the migration, and all of the parameters required for the connection. The name of the ODBC driver is the one you set up when you registered your psqlODBC driver with the driver manager.

Opening the **Database System** dropdown will reveal each RDBMS that is supported on your system. Select PostgreSQL from the list. Below that is the **Stored Connection** dropdown, which is optional. Stored connections will be listed here, which are connections saved after defining a connection with the **Store connection for future use as** checkbox enabled.

The three **Connection Method** options are:

- `ODBC (manually entered parameters)`: Each parameter, like a username, is defined separately
- `ODBC Data Source`: For pre-configured data sources (DSN) -- you can optionally create a DSN using the ODBC Administrator
- `ODBC (direct connection string)`: A full ODBC connection string

Note

The psqlODBC driver does not allow a connection without specifying a database name.

The migration process is similar to other databases. See Section 10.6.4, “PostgreSQL Type Mapping” for information on how the migration wizard migrates types from PostgreSQL to MySQL, and Section 10.2.1, “A visual guide to performing a database migration” for a general migration guide.

10.6.4 PostgreSQL Type Mapping

Table 10.3 Type mapping

Source Type	MySQL Type	Comment
INT	INT	
SMALLINT	SMALLINT	
BIGINT	BIGINT	
SERIAL	INT	Sets AUTO_INCREMENT in its table definition.
SMALLSERIAL	SMALLINT	Sets AUTO_INCREMENT in its table definition.
BIGSERIAL	BIGINT	Sets AUTO_INCREMENT in its table definition.
BIT	BIT	
BOOLEAN	TINYINT(1)	
REAL	FLOAT	
DOUBLE PRECISION	DOUBLE	
NUMERIC	DECIMAL	
DECIMAL	DECIMAL	
MONEY	DECIMAL(19,2)	

Source Type	MySQL Type	Comment
CHAR	CHAR/LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have CHAR columns with a length up to 255 characters. Anything larger is migrated as LONGTEXT
NATIONAL CHARACTER	CHAR/LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types. In MySQL, character set of strings depend on the column character set instead of the datatype.
VARCHAR	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types.
NATIONAL CHARACTER VARYING	VARCHAR/ MEDIUMTEXT/ LONGTEXT	Depending on its length. MySQL Server 5.5 and above can have VARCHAR columns with a length up to 65535 characters. Anything larger is migrated to one of the TEXT blob types. In MySQL, character set of strings depend on the column character set instead of the datatype.
DATE	DATE	
TIME	TIME	
TIMESTAMP	DATETIME	
INTERVAL	TIME	
BYTEA	LONGBLOB	
TEXT	LONGTEXT	
CIDR	VARCHAR(43)	
INET	VARCHAR(43)	
MACADDR	VARCHAR(17)	
UUID	VARCHAR(36)	
XML	LONGTEXT	
JSON	LONGTEXT	
TSVECTOR	LONGTEXT	
TSQUERY	LONGTEXT	
ARRAY	LONGTEXT	
POINT	POINT	
LINE	LINESTRING	Although LINE length is infinite, and LINESTRING is finite in MySQL, it is approximated
LSEG	LINESTRING	A LSEG is like a LINESTRING with only two points
BOX	POLYGON	A BOX is a POLYGON with five points and right angles
PATH	LINESTRING	
POLYGON	POLYGON	

Source Type	MySQL Type	Comment
CIRCLE	POLYGON	A POLYGON is used to approximate a CIRCLE
TXID_SNAPSHOT	VARCHAR	

10.7 MySQL migration

Perform MySQL server version upgrades to move off older MySQL versions to the latest version. The standard migration wizard can migrate MySQL to MySQL, and a simpler **Schema Transfer Wizard** can also be used.

MySQL Schema Transfer Wizard

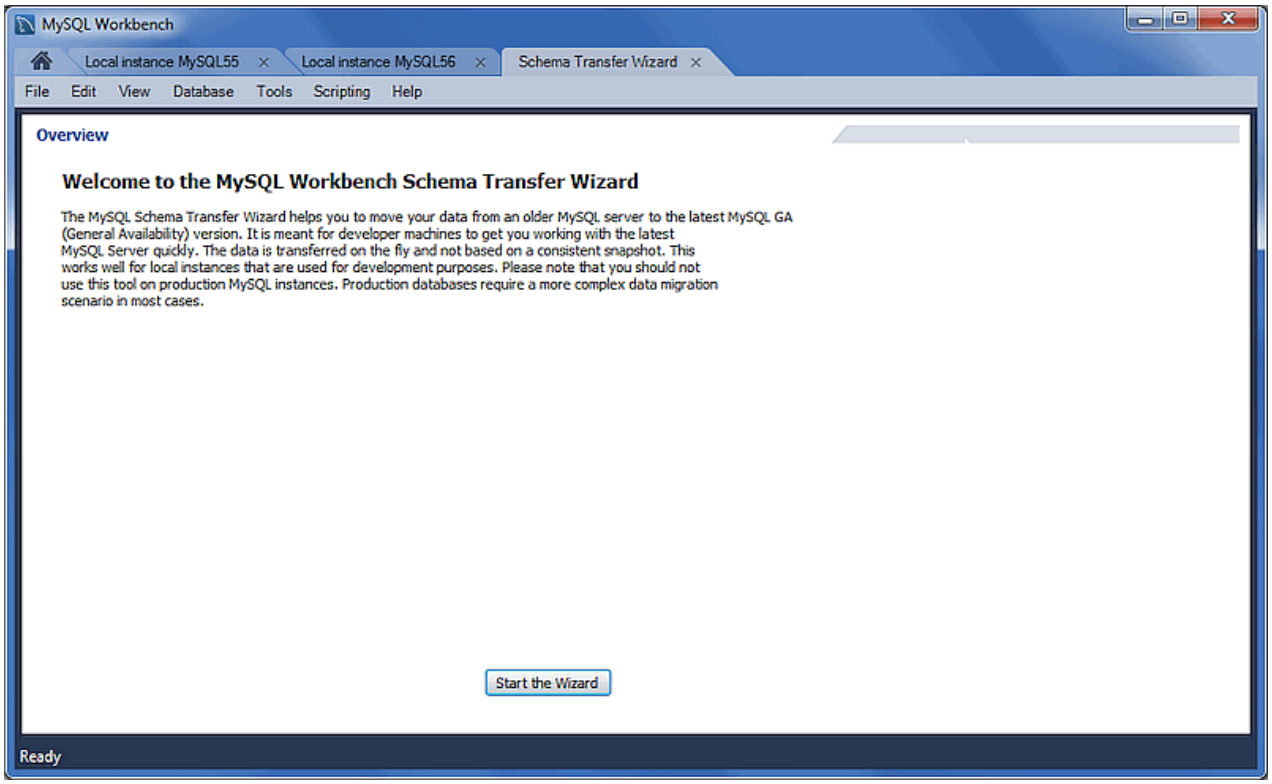
The MySQL Schema Transfer wizard helps you move your data from an older MySQL server version to a different (typically later) MySQL version. This migration tool is meant for developer hosts as it is simpler than the standard migration wizard, because it only migrates MySQL to MySQL. The data is transferred and not based on a consistent snapshot, so it works best on local MySQL instances.

Note

You should not use this wizard on production MySQL instances.

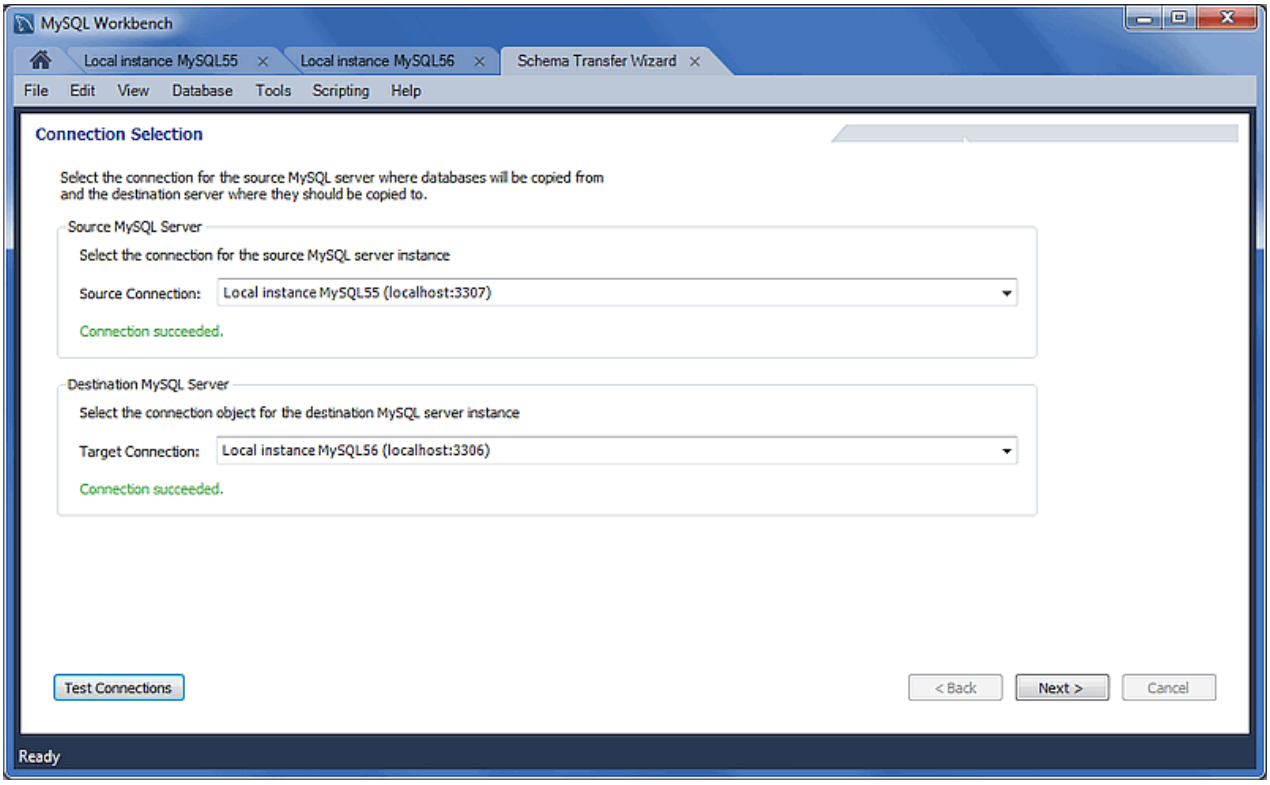
To open the wizard, select Database, Schema Transfer Wizard from the main menu.

Figure 10.47 MySQL Schema Transfer Wizard: Overview


MySQL Workbench
Local instance MySQL55
Local instance MySQL56
Schema Transfer Wizard
File Edit View Database Tools Scripting Help
Overview
Welcome to the MySQL Workbench Schema Transfer Wizard
The MySQL Schema Transfer Wizard helps you to move your data from an older MySQL server to the latest MySQL GA (General Availability) version. It is meant for developer machines to get you working with the latest MySQL Server quickly. The data is transferred on the fly and not based on a consistent snapshot. This works well for local instances that are used for development purposes. Please note that you should not use this tool on production MySQL instances. Production databases require a more complex data migration scenario in most cases.
Start the Wizard
Ready

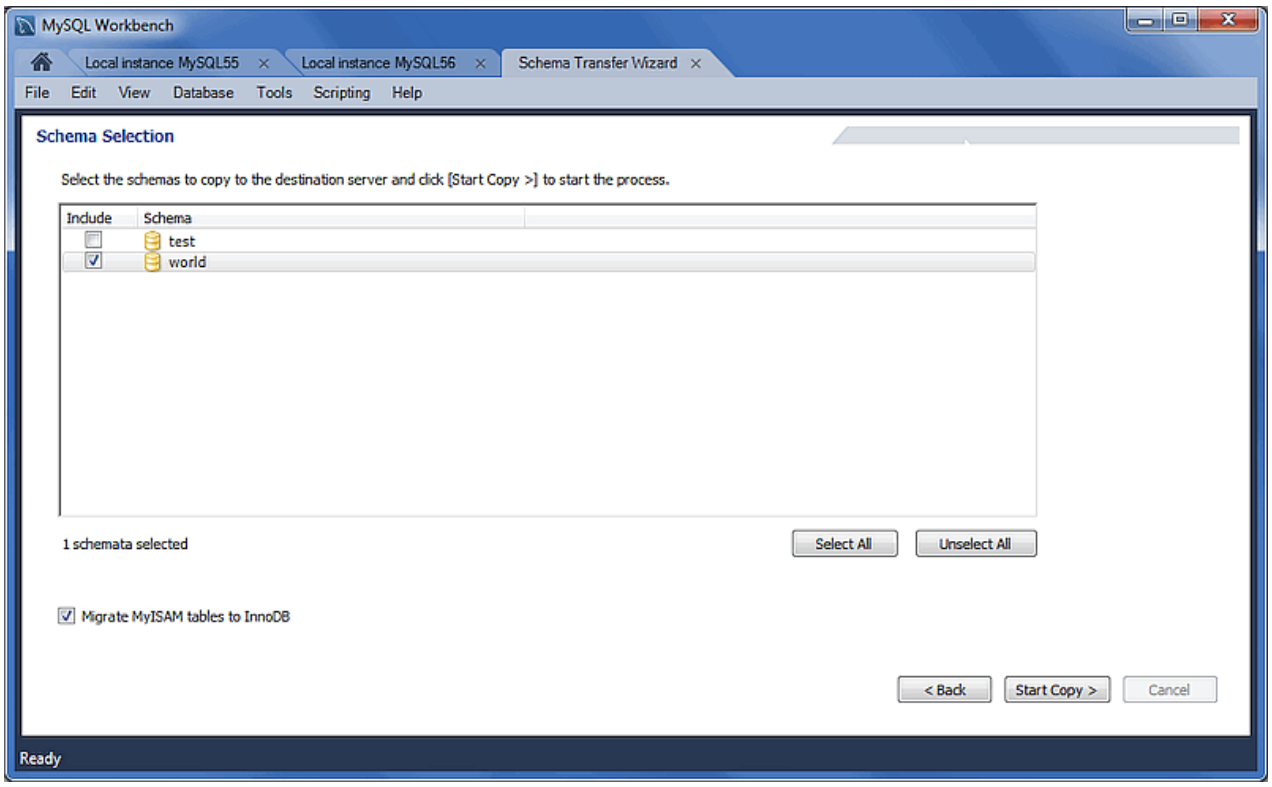
Read the overview text and click Start the Wizard to begin.

Figure 10.48 MySQL Schema Transfer Wizard: Connection Selection


MySQL Workbench
Local instance MySQL55
Local instance MySQL56
Schema Transfer Wizard
File Edit View Database Tools Scripting Help
Connection Selection
Select the connection for the source MySQL server where databases will be copied from and the destination server where they should be copied to.
Source MySQL Server
Select the connection for the source MySQL server instance
Source Connection:
Local instance MySQL55 (localhost:3307)
Connection succeeded.
Destination MySQL Server
Select the connection object for the destination MySQL server instance
Target Connection:
Local instance MySQL56 (localhost:3306)
Connection succeeded.
Test Connections
< Back
Next >
Cancel
Ready

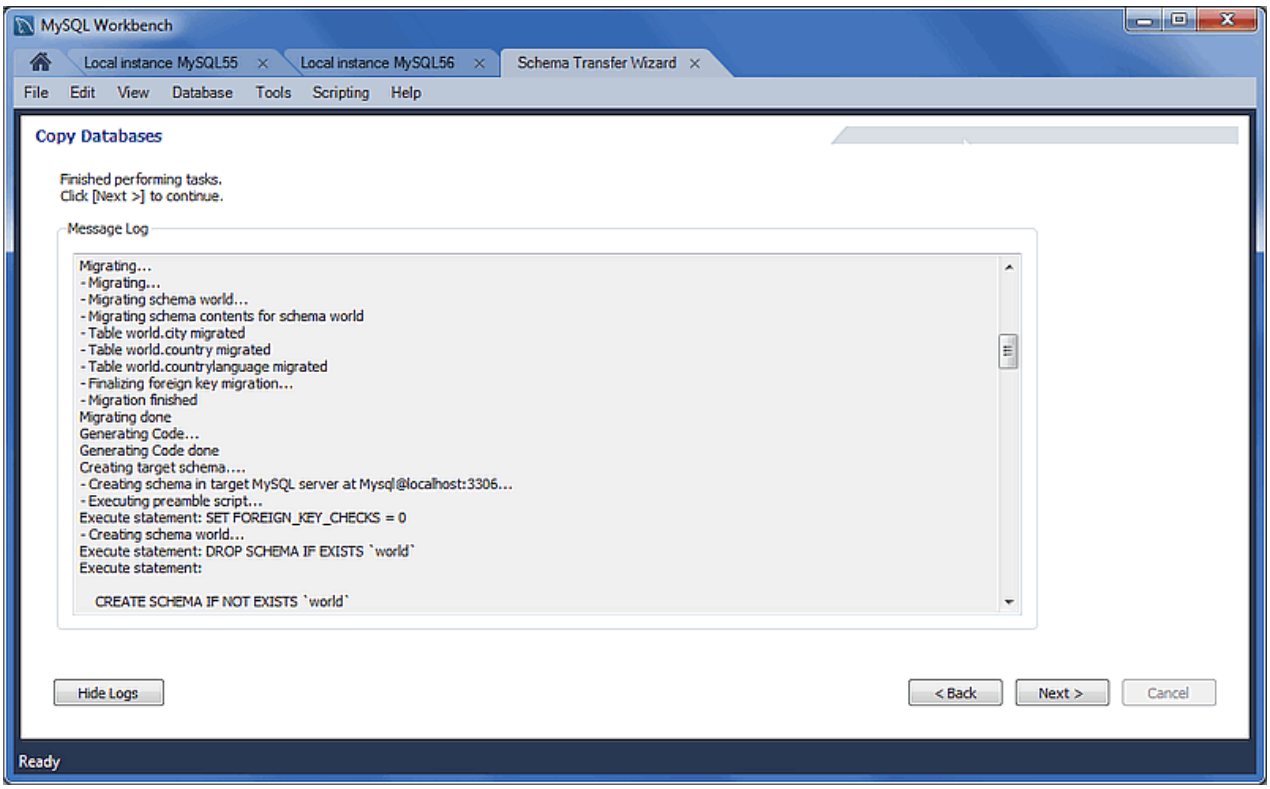
Choose your target and source MySQL connections. After choosing and testing your MySQL connections, click Next to continue.

Figure 10.49 MySQL Schema Transfer Wizard: Schema Selection



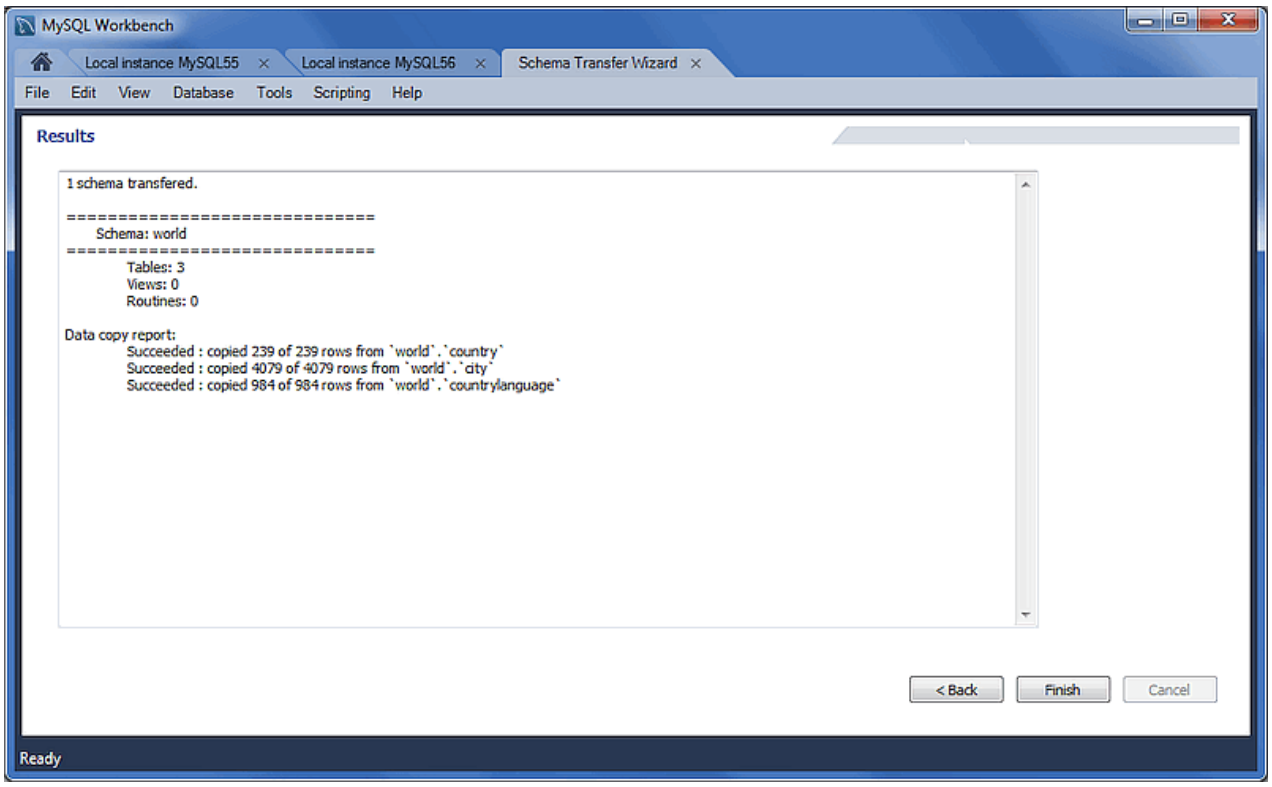
Choose the schemas to migrate, and click Start Copy to begin copying the selected schemas from the source to target MySQL server.

Figure 10.50 MySQL Schema Transfer Wizard: Copy Databases



Review the **Message Log** to confirm that the migration completed with success. Click Next to view a summary of the results.

Figure 10.51 MySQL Schema Transfer Wizard: Results



Click Finish to close the wizard.

10.8 Using the MySQL Workbench Migration Wizard

For a visual walk-through of the migration wizard, see Section 10.2.1, “A visual guide to performing a database migration”.

10.8.1 Connecting to the databases

A connection is made to the source and target database servers.

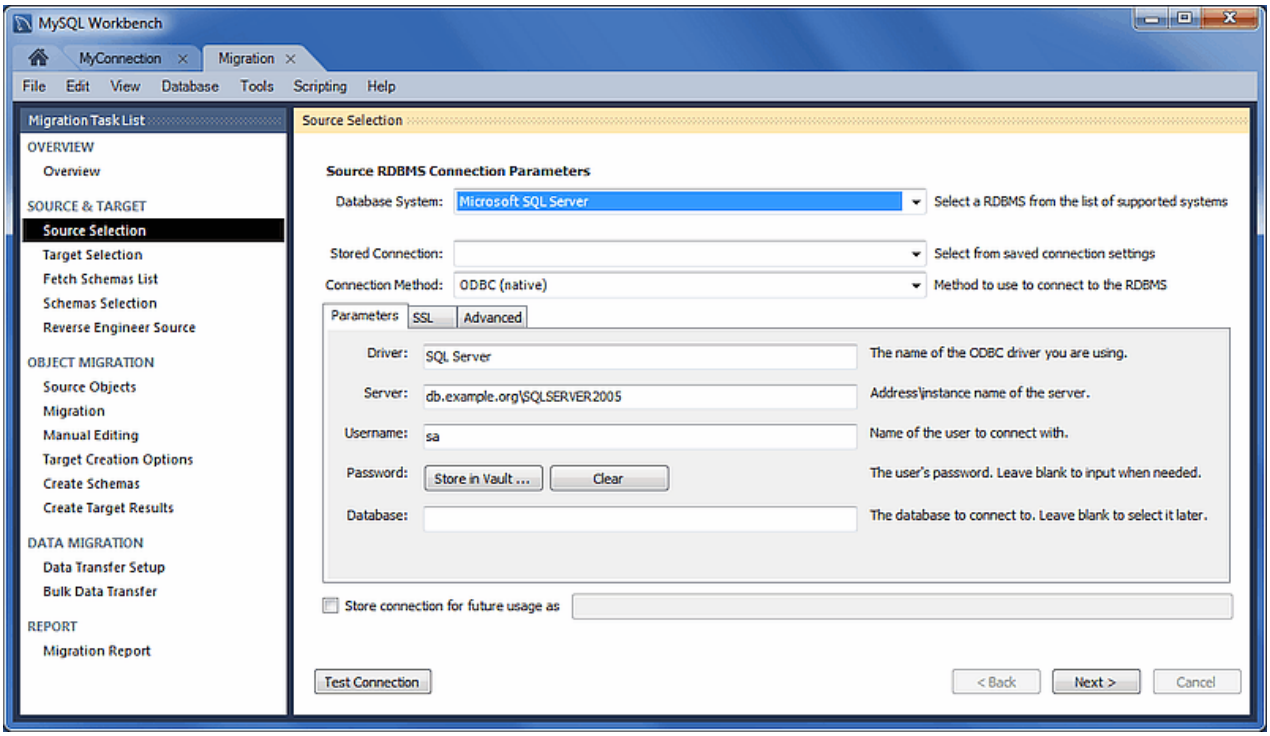
Source Connection

Select the source RDBMS that is migrating to MySQL. Choose the **Database System** that is being migrated, and the other connection parameters will change accordingly.

Note

This connection definition may be saved using the `Store connection for future use as` option, and there is also the Test Connection option.

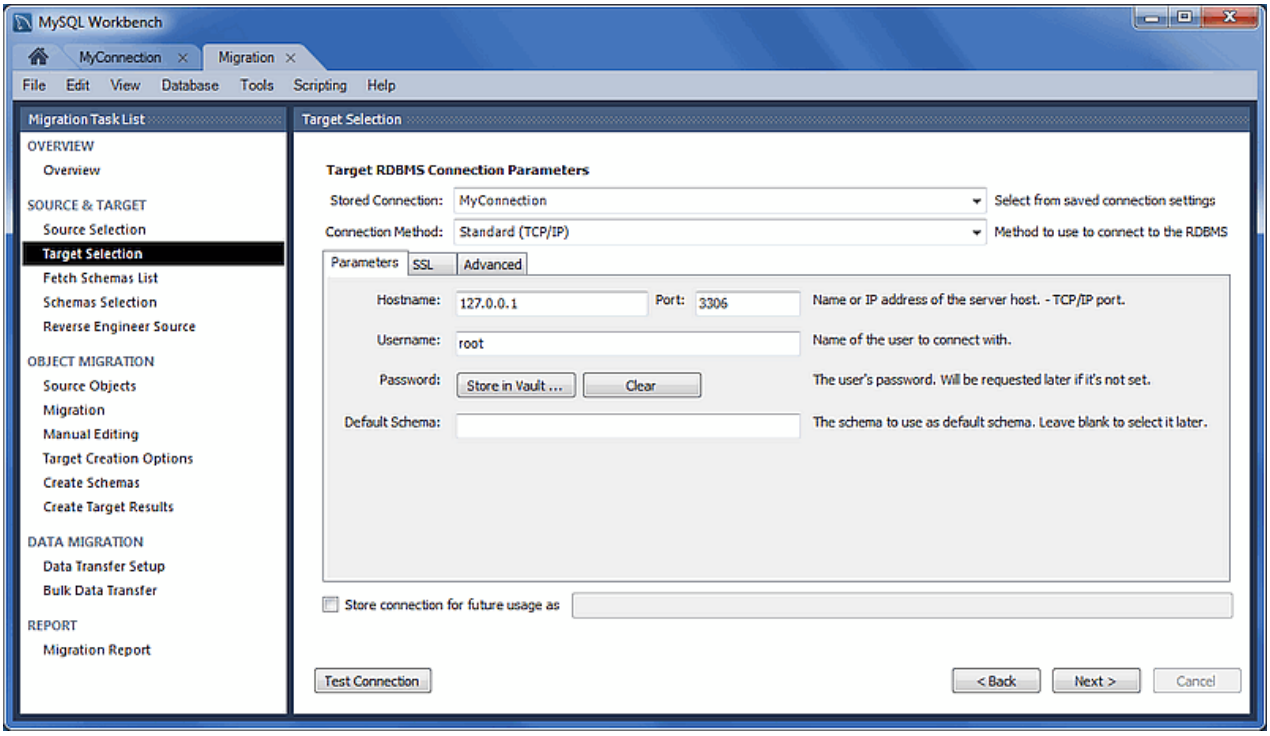
Figure 10.52 MySQL Workbench migration: Source Selection (Parameters)



Target Selection

The target is the MySQL database that will contain the migrated data. Choose an existing MySQL Workbench connection or select Manage DB Connections to create a new MySQL connection.

Figure 10.53 MySQL Workbench migration: Target selection



10.8.2 Schemata Retrieval and Selection

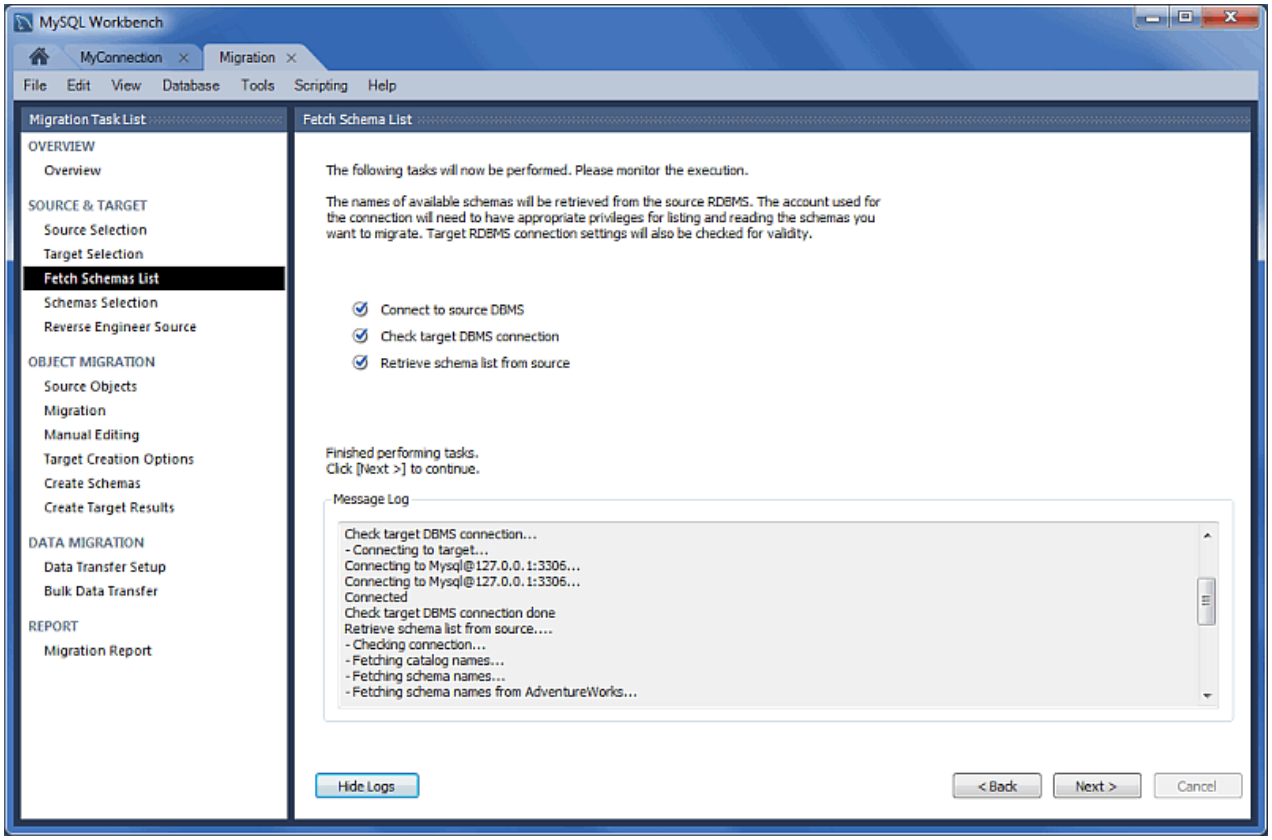
Retrieve a list of available databases and choose the specific databases (and tables) that you want to migrate to MySQL.

Fetch Schemas List

The Schemata list is retrieved from both the source and target RDBMS. The account used for the connection will need to have appropriate privileges for listing and reading the schemas you want to migrate. Target RDBMS connection settings will also be validated. This is an automated and informational step that reports connection related errors and/or general log information.

The steps that are performed include: connects to the source DBMS, checks the connection, and retrieves the schema list from the source.

Figure 10.54 MySQL Workbench migration: Fetch Schemas List



Schemata Selection

Choose the databases you want to migrate over to MySQL.

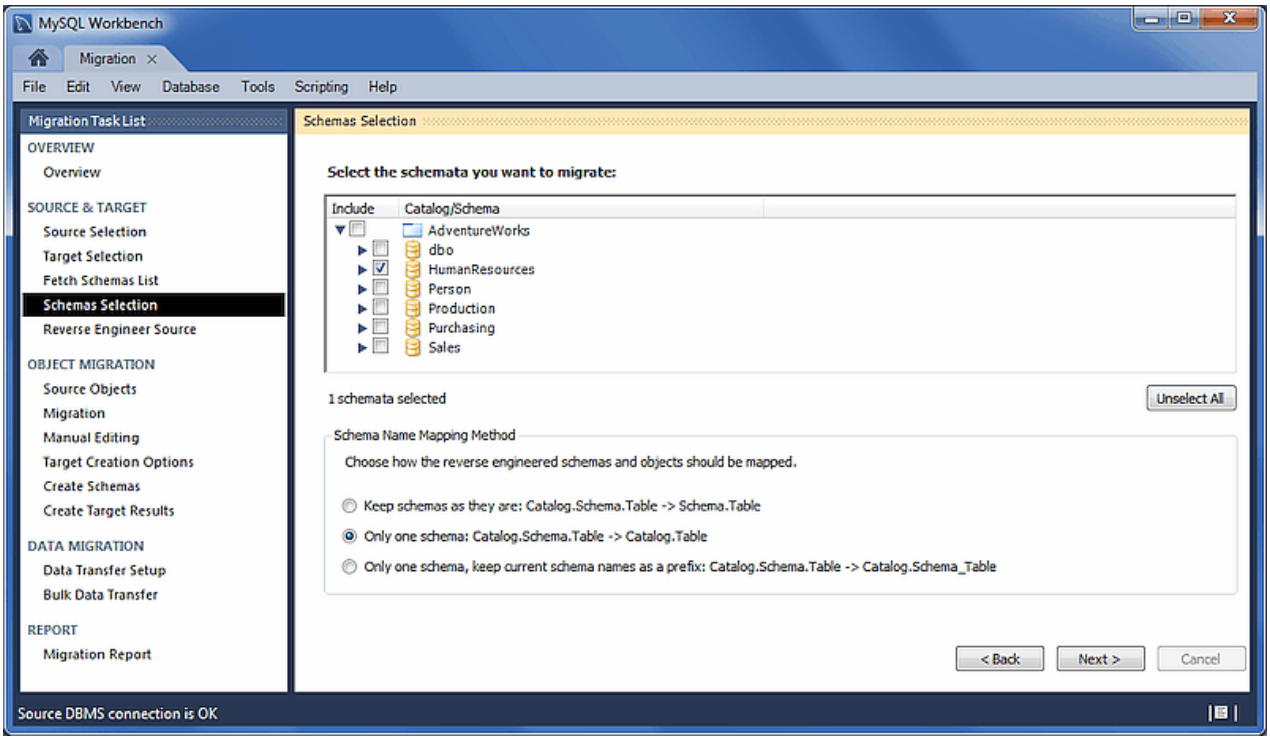
This **Schema Name Mapping Method** options while migrating from Microsoft SQL Server:

Note

This example uses Microsoft SQL Server as the source RDMS. Although the options will be different for other database systems, the concept remains the same.

- Keep schemata as they are: Catalog.Schema.Table -> Schema.Table: This will create multiple databases, one per schema.
- Only one schema: Catalog.Schema.Table -> Catalog.Table: Merges each schema into a single database.
- Only one schema, keep current schema names as a prefix: Catalog.Schema.Table -> Catalog.Schema_table: Preserves the schema name as a prefix.

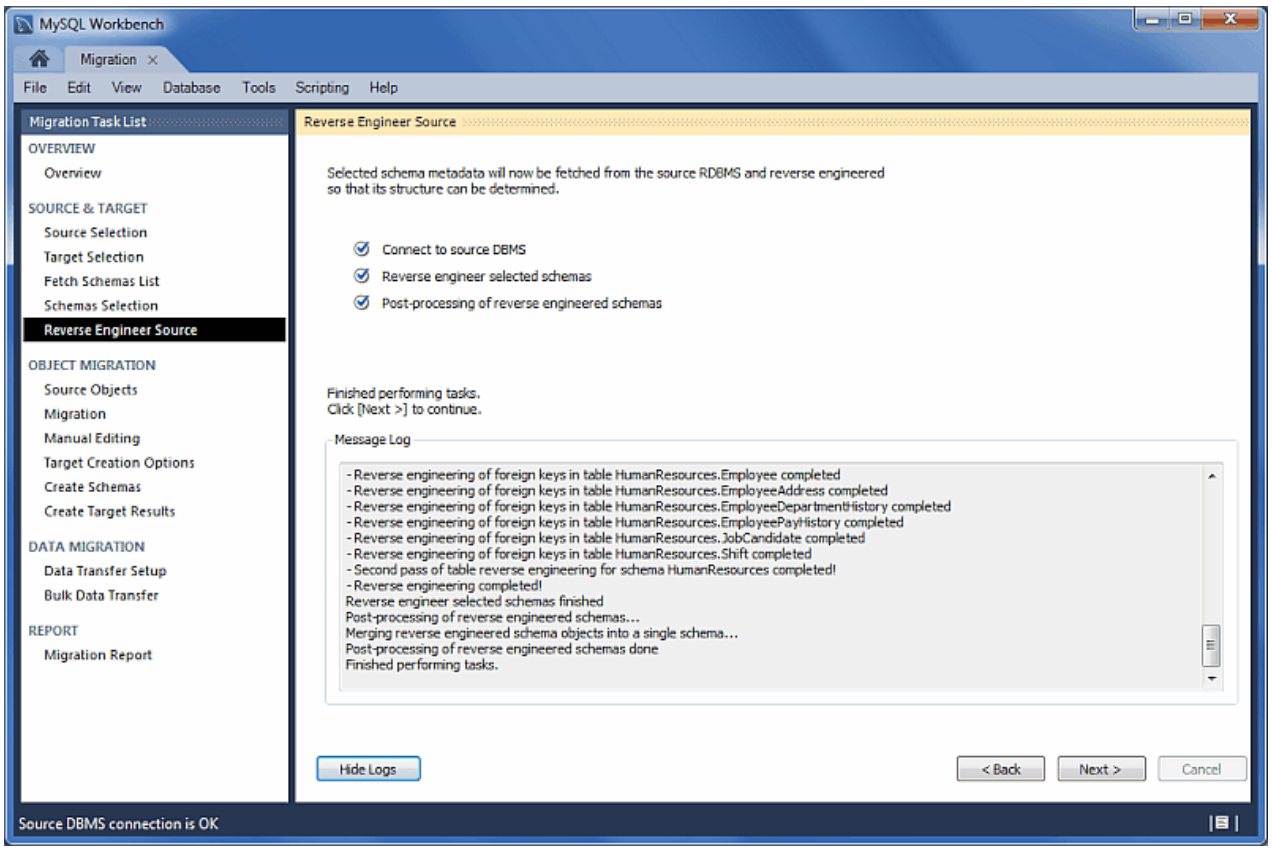
Figure 10.55 MySQL Workbench migration: Schemata Selection



10.8.3 Reverse Engineering

The source metadata is fetched from the source RDBMS, and reverse engineered. This is an automated and informational step that reports related errors and/or general log information. View the logs and then press Next to continue.

Figure 10.56 MySQL Workbench migration: Reverse Engineer Source


MySQL Workbench
Migration
File Edit View Database Tools Scripting Help
Migration Task List
OVERVIEW
Overview
SOURCE & TARGET
Source Selection
Target Selection
Fetch Schemas List
Schemas Selection
Reverse Engineer Source
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Target Creation Options
Create Schemas
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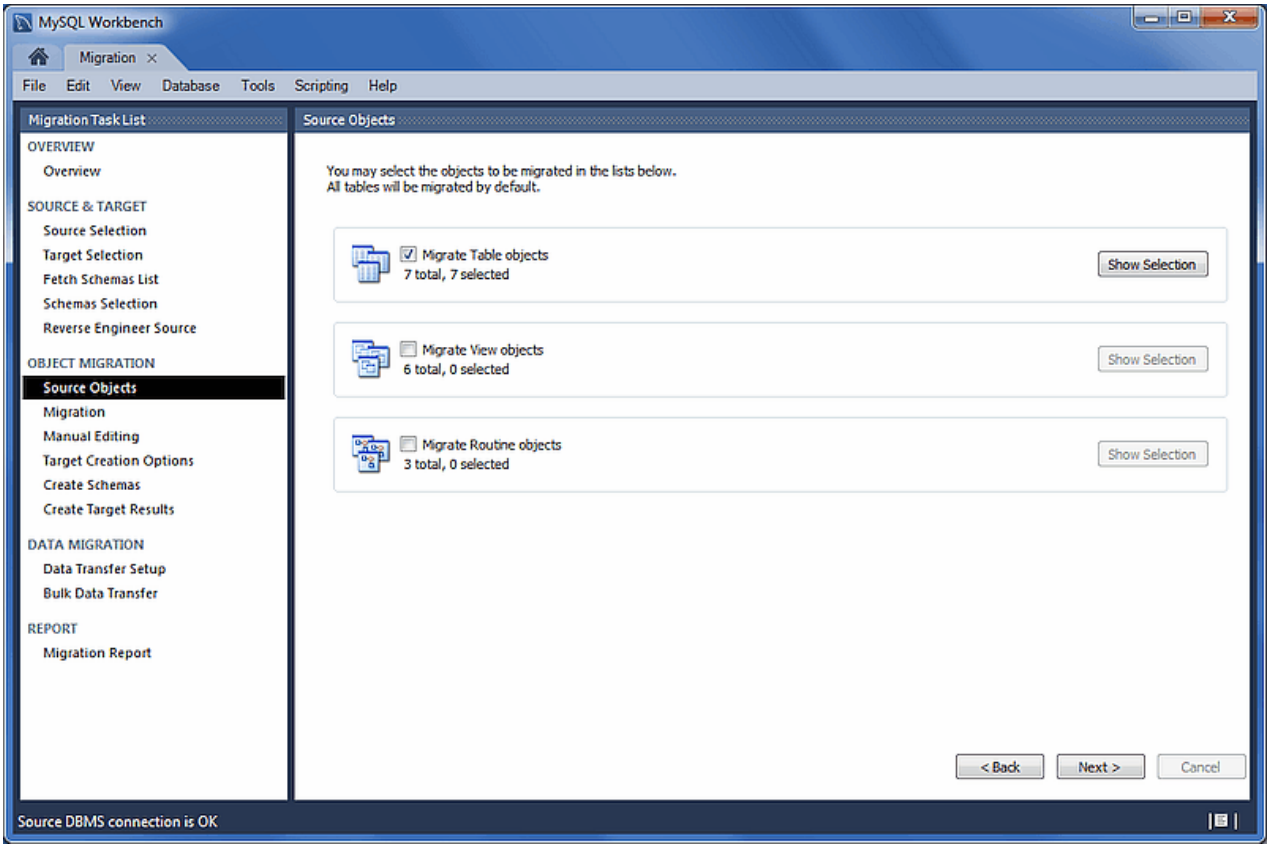
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Reverse Engineer Source
Selected schema metadata will now be fetched from the source RDBMS and reverse engineered so that its structure can be determined.
Connect to source DBMS
Reverse engineer selected schemas
Post-processing of reverse engineered schemas
Finished performing tasks.
Click [Next >] to continue.
Message Log
- Reverse engineering of foreign keys in table HumanResources.Employee completed
- Reverse engineering of foreign keys in table HumanResources.EmployeeAddress completed
- Reverse engineering of foreign keys in table HumanResources.EmployeeDepartmentHistory completed
- Reverse engineering of foreign keys in table HumanResources.EmployeePayHistory completed
- Reverse engineering of foreign keys in table HumanResources.JobCandidate completed
- Reverse engineering of foreign keys in table HumanResources.Shift completed
- Second pass of table reverse engineering for schema HumanResources completed!
- Reverse engineering completed!
Reverse engineer selected schemas finished
Post-processing of reverse engineered schemas...
Merging reverse engineered schema objects into a single schema...
Post-processing of reverse engineered schemas done
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel
Source DBMS connection is OK

10.8.4 Object Selection

Objects discovered by the **Reverse Engineer Source** stage are made available here. This includes Table, View, and Routine objects, with only the Table objects being selected by default. Use the Show Selection button in order to disable individual table objects from being migrated.

Figure 10.57 MySQL Workbench migration: Source Objects

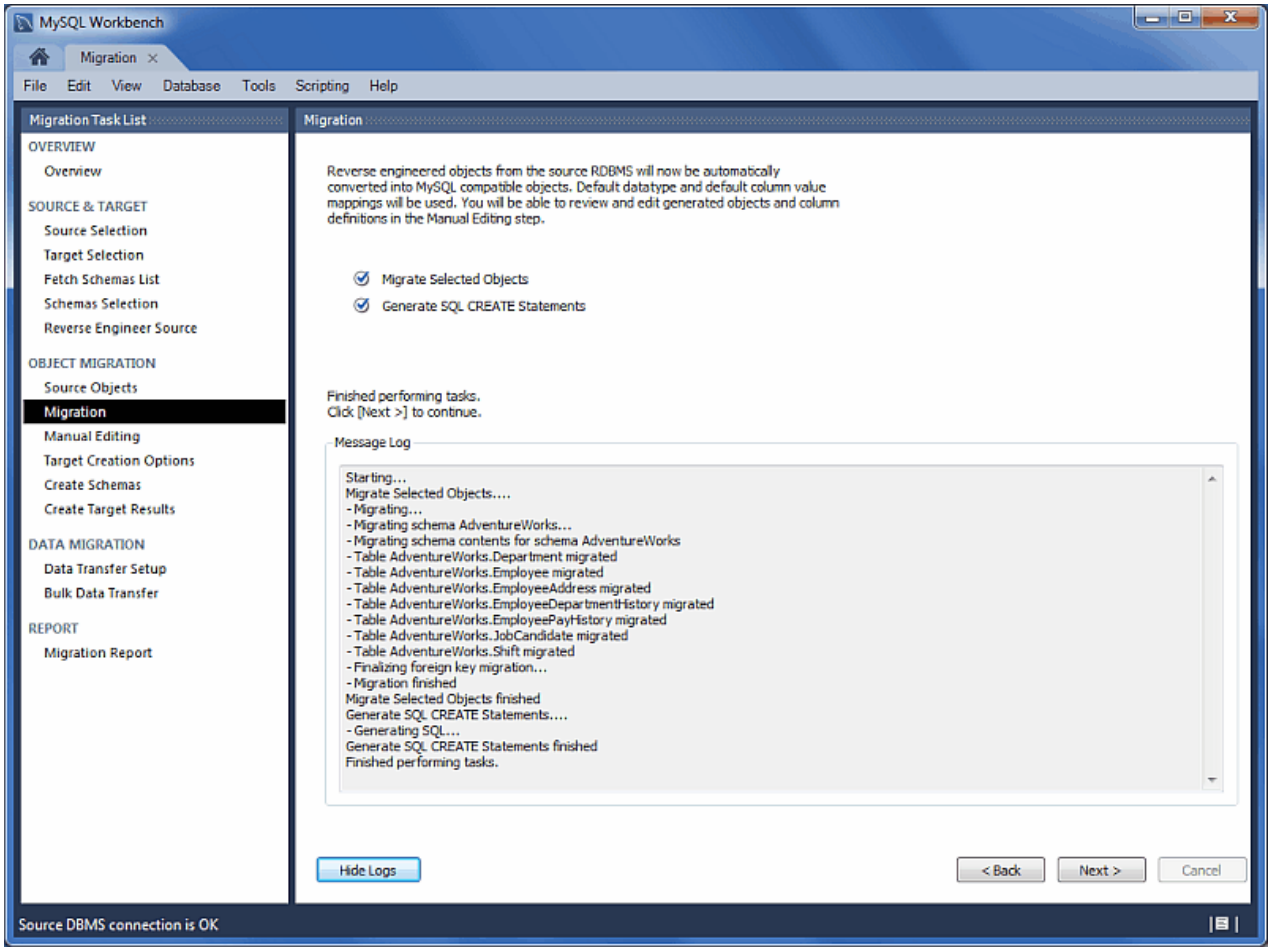


10.8.5 Migration

Reverse engineered objects from the source RDBMS are automatically converted to MySQL compatible objects. Default data type and default column value mappings are used, and the generated objects and column definitions may be reviewed and edited in the next step.

The steps performed include Migrating the selected objects, and generating the SQL CREATE statements.

Figure 10.58 MySQL Workbench migration: Migration



10.8.6 Manual Editing

Use the **View** select box to choose the section to edit. The Show Code and Messages button is available with on every page, and it shows the generated MySQL code that corresponds to the selected object.

- Migration Problems: This either reports problems or displays "No mapping problems found." It is an informational screen.
- All Objects: An object view that allows you to view and edit the object definitions. Double-click on a row to modify a target objects name.
- Column Mappings: Shows all of the table column mappings, and allows you to individually review and fix the mapping for all column types, default values, and other attributes.

Figure 10.59 MySQL Workbench migration: Manual Editing (Migration Problems)

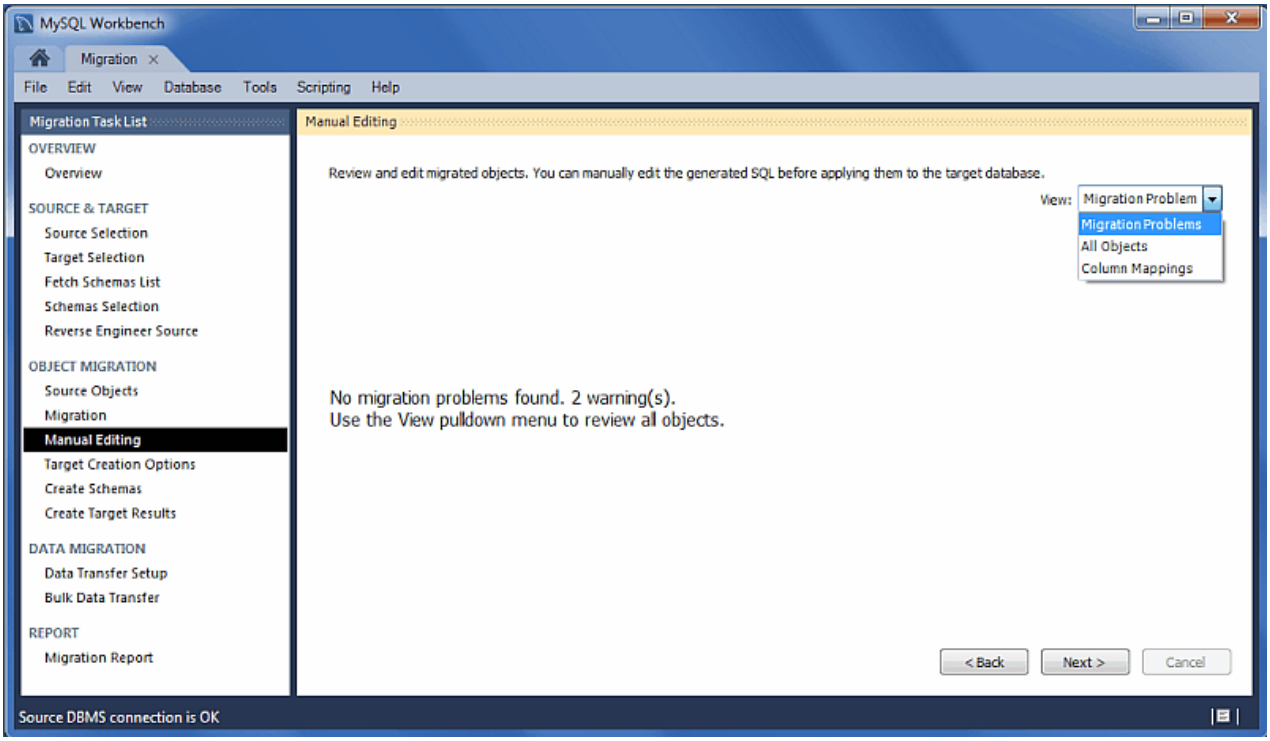


Figure 10.60 MySQL Workbench migration: Manual Editing (All Objects)

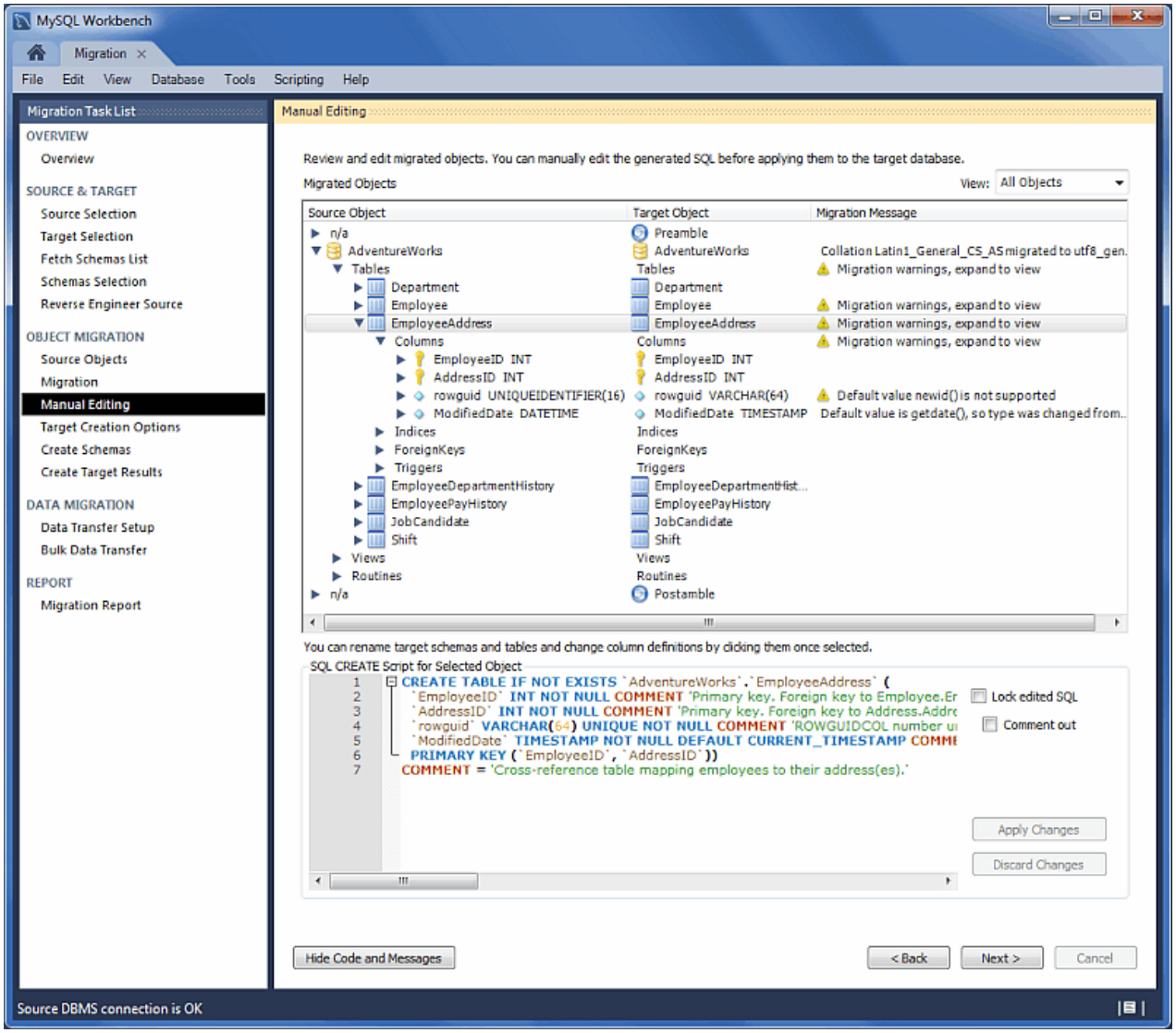
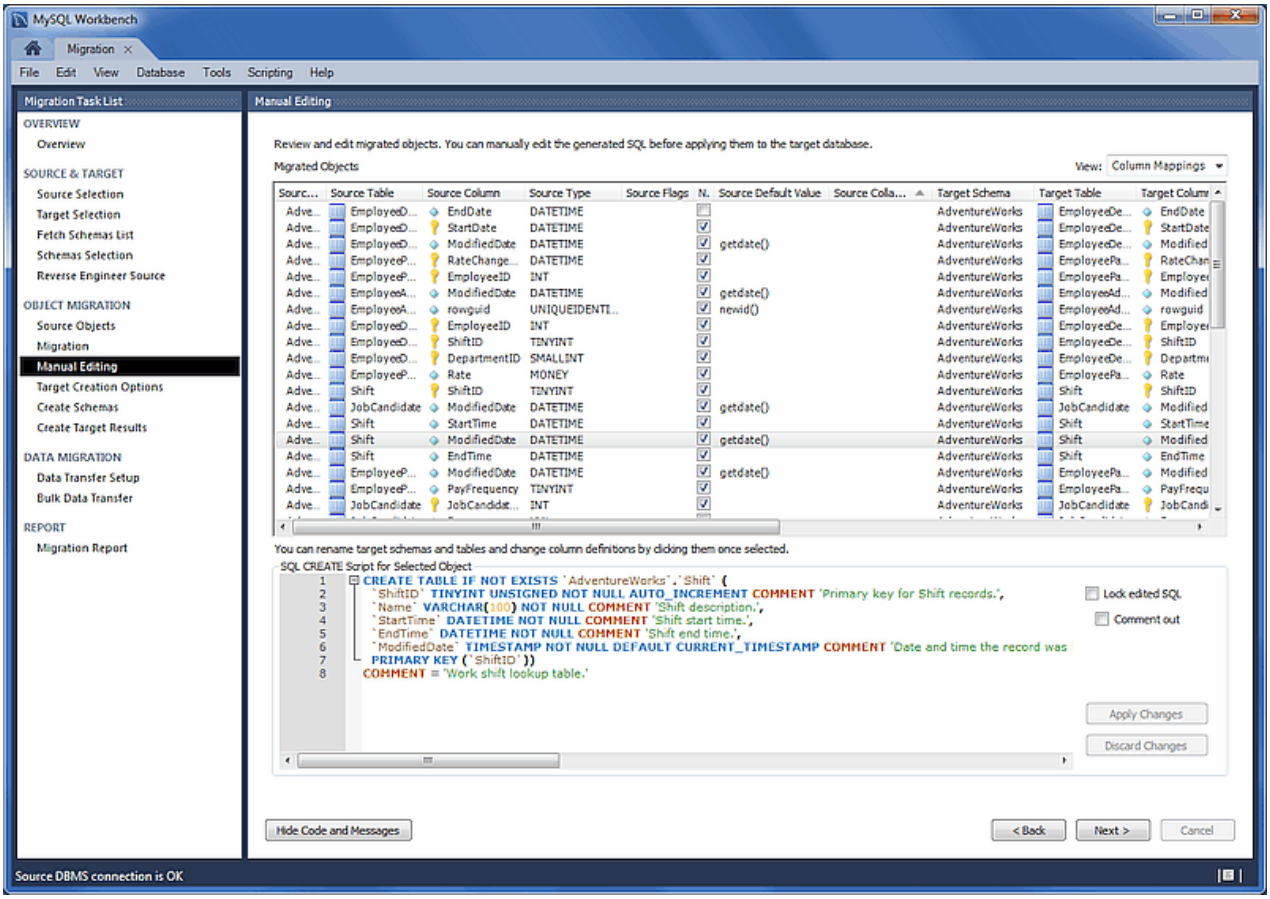


Figure 10.61 MySQL Workbench migration: Manual Editing (Column Mappings)

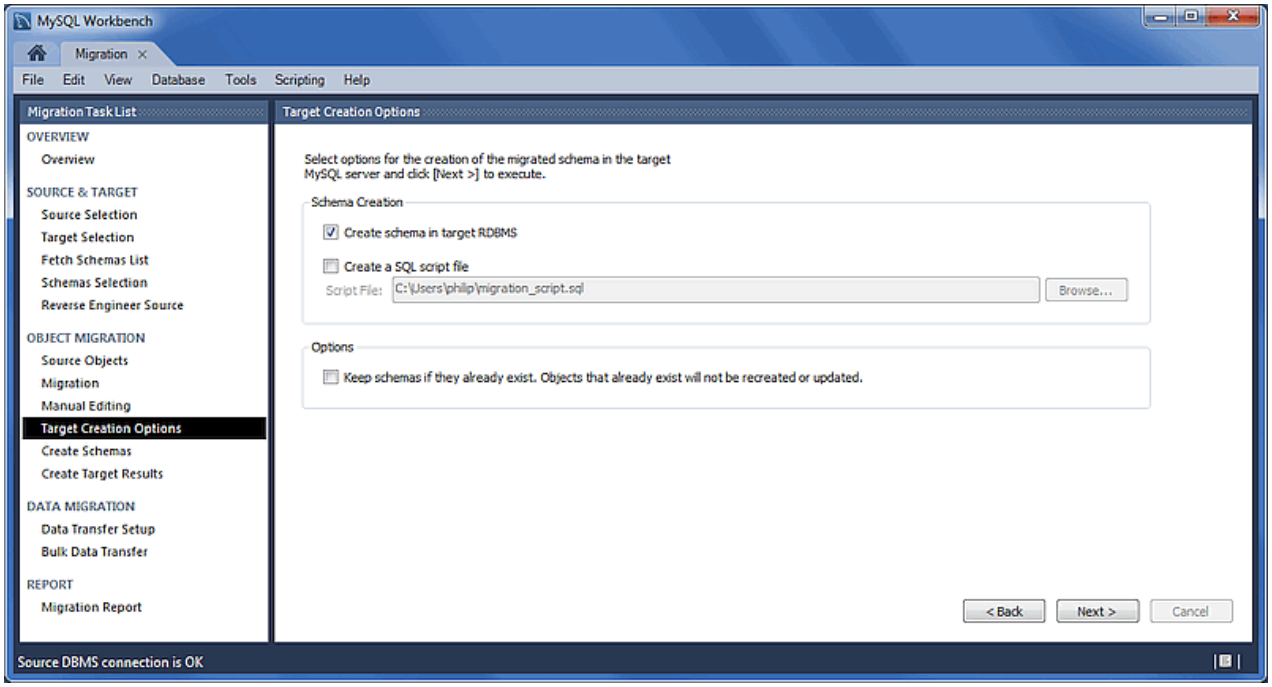


10.8.7 Target Creation Options

Defines addition settings for the target schema. Configuration options include:

- `Create schema in target RDBMS`:
- `Create a SQL script file`:
- An option to keep the schemata if they already exist. Objects that already exist will not be recreated or update.

Figure 10.62 MySQL Workbench migration: Target Creation Options

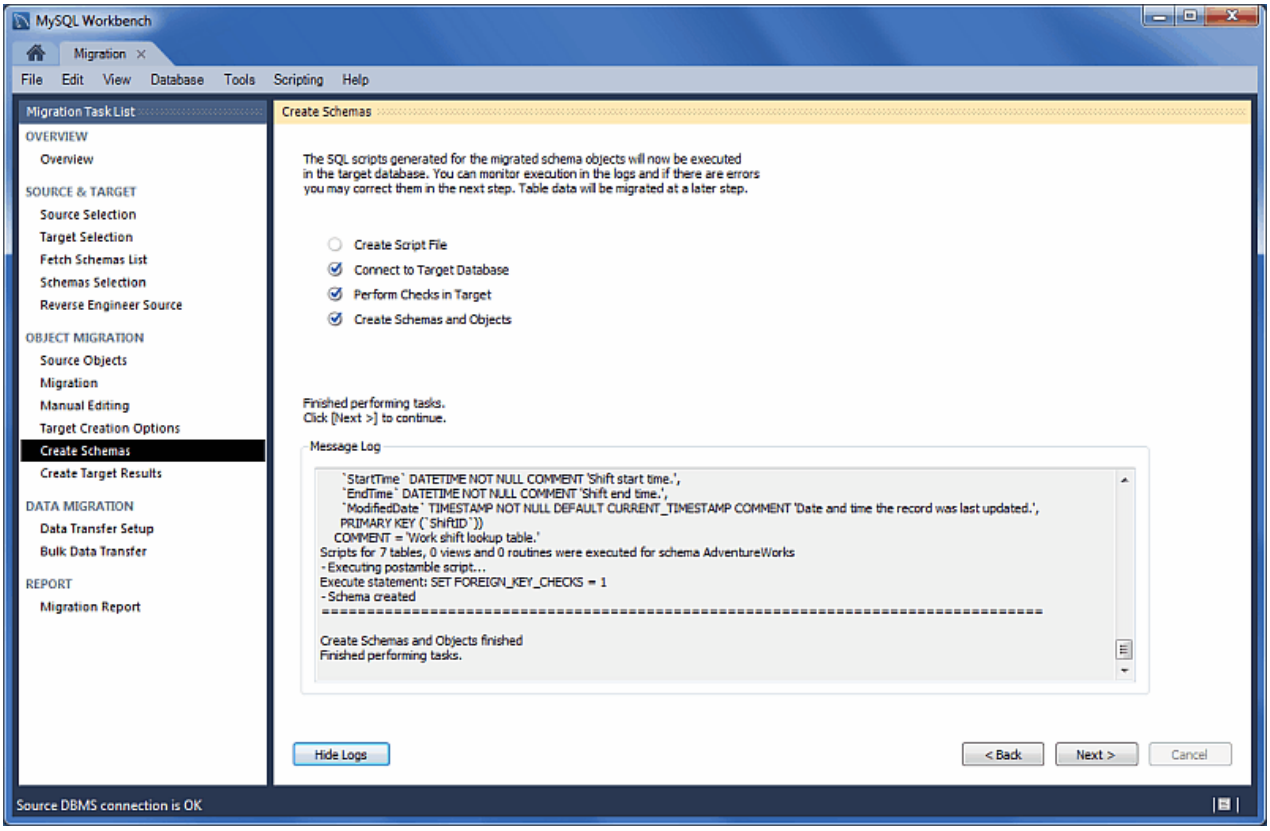


10.8.8 Schema Creation

The SQL scripts generated for the migrated schema objects will now be executed in the target database. You can monitor execution in the logs, if errors exist then they will be fixed in the next step. Table data will be migrated in a later step as well.

This is an automated step, where the actions include: Create Script File, Connect to Target Database, and Create Schemata and Objects.

Figure 10.63 MySQL Workbench migration: Create Schemata


MySQL Workbench
Migration
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Create Schemas
The SQL scripts generated for the migrated schema objects will now be executed in the target database. You can monitor execution in the logs and if there are errors you may correct them in the next step. Table data will be migrated at a later step.
Create Script File
Connect to Target Database
Perform Checks in Target
Create Schemas and Objects
Finished performing tasks.
Click [Next >] to continue.
Message Log
`StartTime` DATETIME NOT NULL COMMENT 'Shift start time.',
`EndTime` DATETIME NOT NULL COMMENT 'Shift end time.',
`ModifiedDate` TIMESTAMP NOT NULL DEFAULT CURRENT_TIMESTAMP COMMENT 'Date and time the record was last updated.',
PRIMARY KEY (`ShiftID`))
COMMENT = 'Work shift lookup table.'
Scripts for 7 tables, 0 views and 0 routines were executed for schema AdventureWorks
- Executing postamble script...
Execute statement: SET FOREIGN_KEY_CHECKS = 1
- Schema created
Create Schemas and Objects finished
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel
Source DBMS connection is OK

10.8.9 Create Target Results

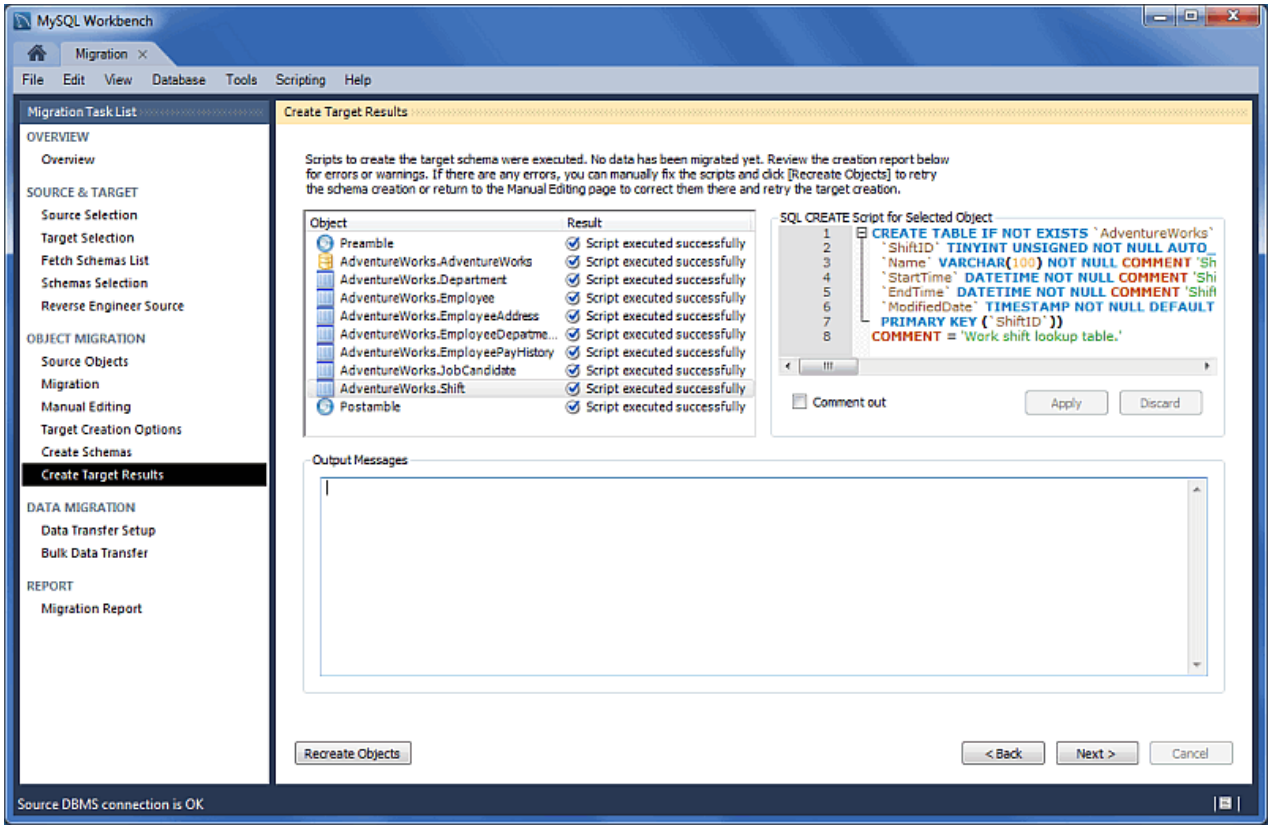
The generated objects are listed here, along with the error messages if any exist.

The migration code may also be viewed and edited here. To make changes, select an object, edit the query code, and press Apply. Repeat this process for each object that will be edited. And then, press Recreate Objects to save the results.

Note

The Recreate Objects operation is required to save any changes here. It will then execute the previous migration step (**Create Schemata**) with the modified code, and then continue the migration process. This also means that the previously saved schema will be dropped.

Figure 10.64 MySQL Workbench migration: Create Target Results



10.8.10 Data Transfer and Migration Setup

Transfers data from the source RDBMS to the target MySQL database. The setup screen includes the following options:

Data Copy:

- *Online copy of table data to target RDBMS*: This (default) will copy the data to the target RDBMS.
- *Create a batch file to copy the data at another time*: The data may also be dumped to a file that can be executed at a later time, or be used as a backup. This script uses a MySQL connection to transfer the data.
- *Create a shell script to use native server dump and load abilities for fast migration*: Unlike the simple batch file that performs a live online copy, this generates a script to be executed on the *source* host to then generate a Zip file containing all of the data and information needed to migrate the data locally on the target host. Copy and extract the generated Zip file on the target host and then execute the import script (on the target host) to import the data into MySQL using a LOAD DATA call.

  This faster method avoids the need to traffic all data through MySQL Workbench, or to have a permanent network connection between the MySQL servers.

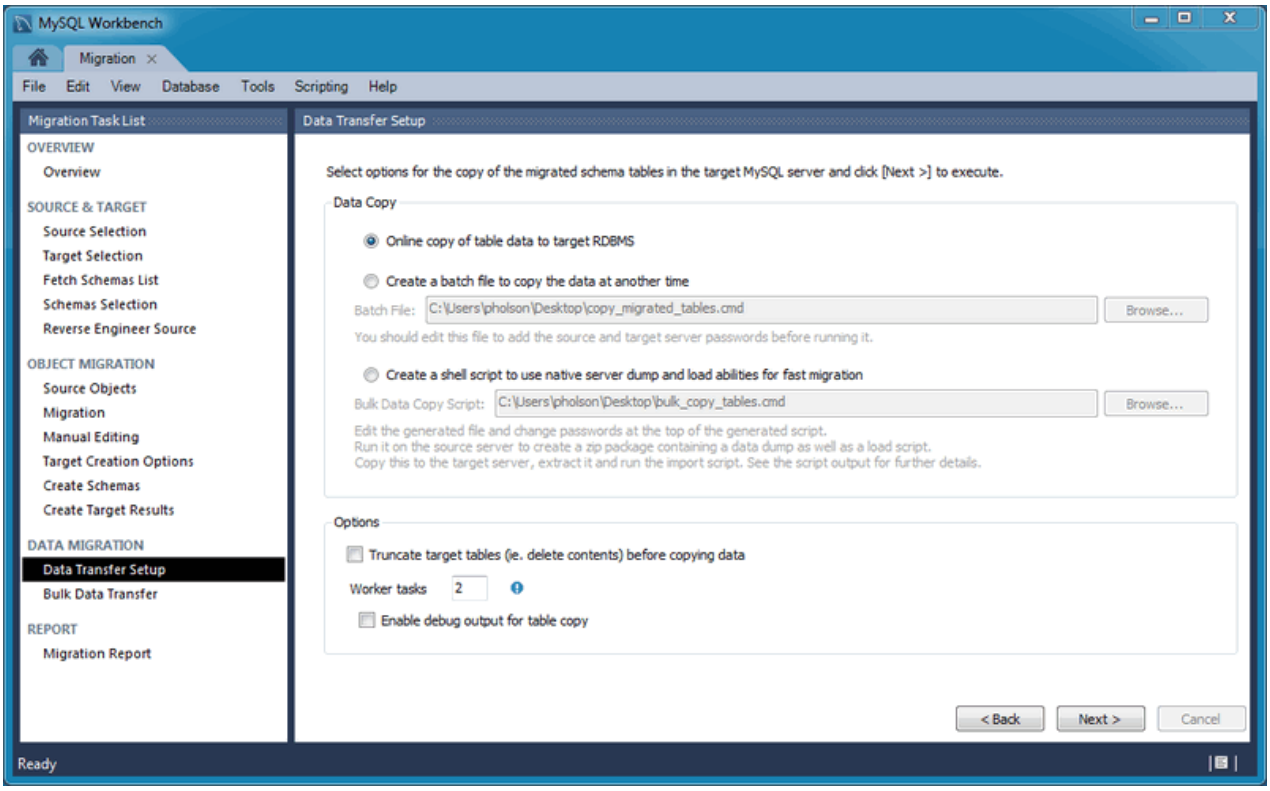
Note

This option was added in MySQL Workbench 6.3.0.

Options:

- Truncate target tables before copying data: In case the target database already exists, this will delete said data.
- Worker tasks: The default value is 2. This is the number of tasks (database connections) used while copying the data.
- Enable debug output for table copy: Shows debugging information.

Figure 10.65 MySQL Workbench migration: Data Transfer Setup


MySQL Workbench
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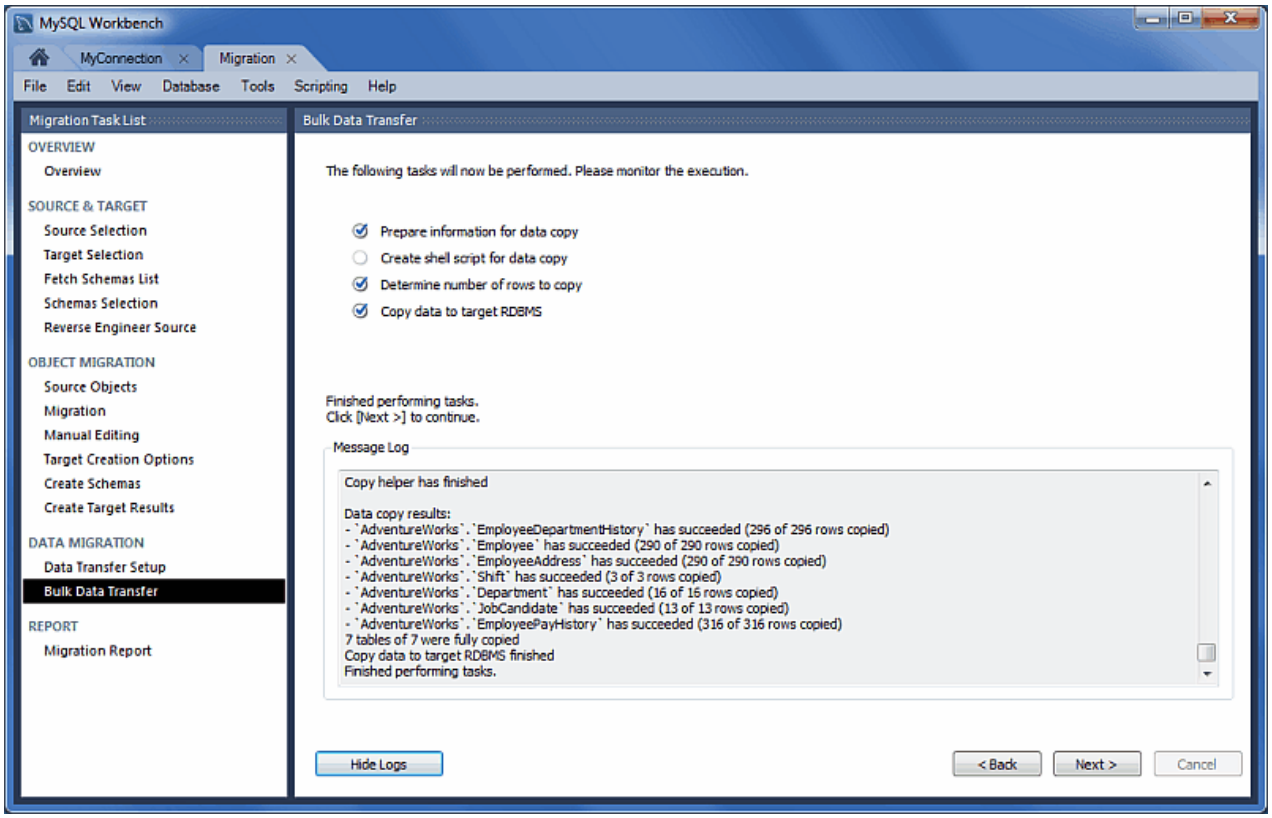
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Data Transfer Setup
Select options for the copy of the migrated schema tables in the target MySQL server and click [Next >] to execute.
Data Copy
Online copy of table data to target RDBMS
Create a batch file to copy the data at another time
Batch File: C:\Users\pholson\Desktop\copy_migrated_tables.cmd
Browse...
You should edit this file to add the source and target server passwords before running it.
Create a shell script to use native server dump and load abilities for fast migration
Bulk Data Copy Script: C:\Users\pholson\Desktop\bulk_copy_tables.cmd
Browse...
Edit the generated file and change passwords at the top of the generated script.
Run it on the source server to create a zip package containing a data dump as well as a load script.
Copy this to the target server, extract it and run the import script. See the script output for further details.
Options
Truncate target tables (ie. delete contents) before copying data
Worker tasks 2
Enable debug output for table copy
< Back
Next >
Cancel
Ready

10.8.11 Bulk Data Transfer

Depending on the selected option, this will either transfer the data to the target RDMS (default), generate a simple script for the online data transfer, or generate script to execute on the source host that then generates a Zip file containing both the transfer script and data that will be executed on the target host. Optionally, view the logs to confirm.

Figure 10.66 MySQL Workbench migration: Bulk Data Transfer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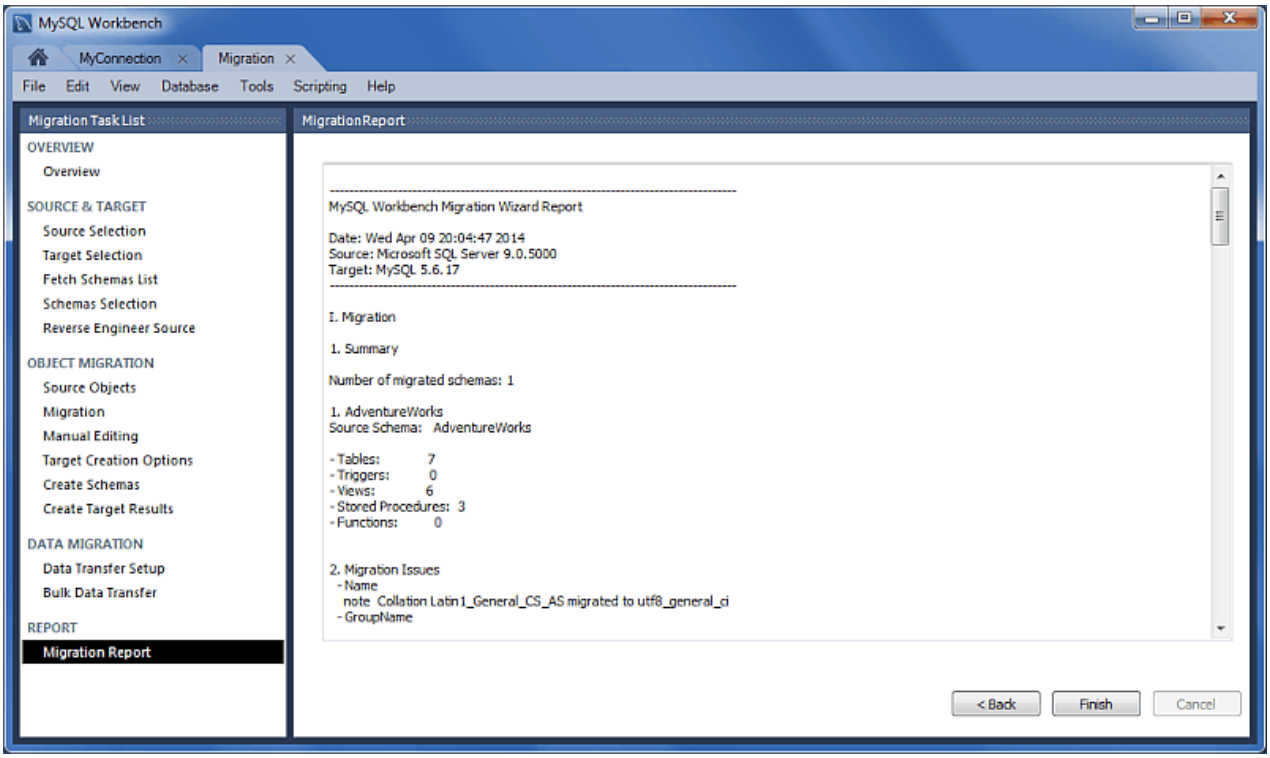
Target Creation Options
Create Schemas
Create Target Results
DATA MIGRATION
Data Transfer Setup
Bulk Data Transfer
REPORT
Migration Report
Bulk Data Transfer
The following tasks will now be performed. Please monitor the execution.
Prepare information for data copy
Create shell script for data copy
Determine number of rows to copy
Copy data to target RDBMS
Finished performing tasks.
Click [Next >] to continue.
Message Log
Copy helper has finished
Data copy results:
- `AdventureWorks`.`EmployeeDepartmentHistory` has succeeded (296 of 296 rows copied)
- `AdventureWorks`.`Employee` has succeeded (290 of 290 rows copied)
- `AdventureWorks`.`EmployeeAddress` has succeeded (290 of 290 rows copied)
- `AdventureWorks`.`Shift` has succeeded (3 of 3 rows copied)
- `AdventureWorks`.`Department` has succeeded (16 of 16 rows copied)
- `AdventureWorks`.`JobCandidate` has succeeded (13 of 13 rows copied)
- `AdventureWorks`.`EmployeePayHistory` has succeeded (316 of 316 rows copied)
7 tables of 7 were fully copied
Copy data to target RDBMS finished
Finished performing tasks.
Hide Logs
< Back
Next >
Cancel

10.8.12 Migration Report

Displays the final report that summarizes the migration process.

Figure 10.67 MySQL Workbench migration: Migration Report



10.9 MySQL Workbench Migration Wizard FAQ

Frequently Asked Questions with answers.

10.9.1 While using the Postgresql psqlodbc driver, I see the following error: `('08001', '[08001] Already connected. (202) (SQLDriverConnect)')` 411

10.9.1. While using the Postgresql psqlodbc driver, I see the following error: `('08001', '[08001] Already connected. (202) (SQLDriverConnect)')`

This means that PostgreSQL is not configured to accept connections from the source IP.

Appendix A MySQL Workbench Frequently Asked Questions

FAQ Categories

- **Basic Usage** [413]
- **MySQL Workbench Functionality** [414]
- **Data Management** [416]
- **General** [417]

Basic Usage

A.1 What is a MySQL connection? Why might I need to create more than one? 413
A.2 How do I create a MySQL database (schema) in MySQL Workbench? 413
A.3 Is there an easy way to select all data from a table, and then see the results? 413

A.1. What is a MySQL connection? Why might I need to create more than one?

A MySQL connection links (connects) Workbench to a MySQL server. Most actions performed within Workbench are then performed against the connected MySQL server. Each MySQL connection contains its own set of definitions, so you might define multiple MySQL connections in Workbench. For example, the connections might connect to different MySQL servers, or the same MySQL server with different user names, or enable SSL for one, or you might set up a connection to a remote MySQL server (on your web host?) using the SSH options, and so on.

As for multiple connections to the same local MySQL server, you might have one connection using "root" with another using a less privileged user. Depending on how you set up the users, they may (or may not) both have rights to see and use the same databases (information). For example, you might use Workbench to configure and use the less-privileged user that you use for your web application.

So to summarize, connections simply connect to the MySQL server. If two connections use the same exact information then the results in Workbench will be identical. However, that is not a common use case. For additional information about MySQL connections in MySQL Workbench, see Chapter 5, *MySQL Connections*.

A.2. How do I create a MySQL database (schema) in MySQL Workbench?

- Open a MySQL connection to open the SQL editor.
- On the left pane there is an Object Browser that contains two tabs titled **Management** and **Schemas**. Choose the schemas tab (default).
- Right-click anywhere in the **Schemas** pane and choose Create Schema from the context-menu.
- Follow the schema creation wizard by naming your new schema, and click Apply to create your new schema.

Other options include clicking the "Create Schema" icon on the main navigation bar, or executing a "CREATE SCHEMA your_db_name" query in the SQL editor.

A.3. Is there an easy way to select all data from a table, and then see the results?

From the schema navigator, hover over the table and click the icon. This executes a "SELECT * FROM schema.table" query and loads the results into the result grid. From there you can view or edit the data.

Alternatively, right-click on a table and select Select Rows - Limit 1000 form the context menu.

Workbench Functionality

A.1 How do I use the SSL Certificate wizard to enable SSL for both my MySQL server and MySQL client? 414
A.2 How do I copy my saved MySQL connections in Workbench to a different computer? 414
A.3 How can I view my MySQL Workbench query history? 414
A.4 Can I preserve a results tab rather than have it refresh every time I execute a statement? 414
A.5 How does the embedded web browser functionality work? For example, clicking **Workbench Forum** on the Home screen opens the forum in its own embedded MySQL Workbench tab. 414
A.6 How does MySQL Workbench increase import performance? 415

A.1. How do I use the SSL Certificate wizard to enable SSL for both my MySQL server and MySQL client?

Execute the wizard to generate the SSL certificates, and then modify your MySQL server's configuration file (`my.cnf` or `my.ini`) accordingly. You can copy-n-paste entries for the SSL options from the generated `sample-my.cnf` sample file. Next, confirm that the SSL **CA File**, **CERT File**, and **Key File** values are properly set under the **SSL** tab for your MySQL connection. Set **Use SSL** to either *Require* (recommended) or *If available*, and then execute Test Connection. This should report that SSL is enabled.

Failed SSL connections are logged in the MySQL Workbench log file. For additional information about the log file's location, see Section 3.3, “MySQL Workbench Settings and Log Files”.

For additional information, see Section 5.3.4, “SSL Wizard (Certificates)”.

A.2. How do I copy my saved MySQL connections in Workbench to a different computer?

From the main navigation menu, choose Tools, Configuration, and then Backup Connections to create a Zip file with your configured MySQL connections. Next, load this file into your new Workbench instance by using the related Restore Connections option.

A.3. How can I view my MySQL Workbench query history?

In bottom pane, change **Action Output** to **History** and then choose the appropriate date.

The SQL statement history is stored as plain text on your system under your user's MySQL Workbench configuration path in the `sql_history` directory. These files are organized per date (such as 2014-01-15) and contain your MySQL Workbench SQL statement history for all MySQL connections.

A.4. Can I preserve a results tab rather than have it refresh every time I execute a statement?

Yes, you can pin the results tab to force it to remain and be unaffected by UPDATE and other statements. Do that by right-clicking the result tab and choose "Pin Tab" from the context-menu, or left-click the little pin icon to toggle it. Now, execute your other queries and then refresh the pinned tab (there is a "refresh" icon in the result grid's menu).

A.5. How does the embedded web browser functionality work? For example, clicking **Workbench Forum** on the Home screen opens the forum in its own embedded MySQL Workbench tab.

The Webkit system library is used on OS X, Internet Explorer is used on Windows, and Linux opens the default browser externally rather than an embedded browser. Pressing **Modifier** + **Arrow** moves the browser history forward and back.

Additionally, for information about creating your own Home screen links, see Section 3.4, “Tutorial: Add a Custom Link to the Home Page”.

A.6. How does MySQL Workbench increase import performance?

When a model is exported (Database, Forward Engineer...), some MySQL server variables are temporarily set to enable faster SQL import by the server. The statements added at the start of the code are:

```
SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0;
SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0;
SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='TRADITIONAL,ALLOW_INVALID_DATES';
```

These statements function as follows:

- `SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0;`: Determines whether `InnoDB` performs duplicate key checks. Import is much faster for large data sets if this check is not performed. For additional information, see `unique_checks`.
- `SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0;`: Determines whether the server should check that a referenced table exists when defining a foreign key. Due to potential circular references, this check must be turned off for the duration of the import, to permit defining foreign keys. For additional information, see `foreign_key_checks`.
- `SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='TRADITIONAL';`: Sets SQL_MODE to `TRADITIONAL`, causing the server to operate in a more restrictive mode, and `ALLOW_INVALID_DATES`, causing dates to not be fully validated.

These server variables are then reset at the end of the script using the following statements:

```
SET SQL_MODE=@OLD_SQL_MODE;
SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS;
SET UNIQUE_CHECKS=@OLD_UNIQUE_CHECKS;
```

Workbench Behavior

A.1 Why do my query results sometimes say **Read Only** but other times I can edit data in the results grid? 415
A.2 I'm attempting to execute a DELETE query but the query fails with an "Error Code: 1175" error. How do I proceed? 416
A.3 My MySQL server connection is timing out with an error like "Error Code: 2013. Lost connection to MySQL server during query". Can I adjust the timeout? 416
A.4 What do the column flag acronyms (PK, NN, UQ, BIN, UN, ZF, AI) in the MySQL Workbench Table Editor mean? 416

A.1. Why do my query results sometimes say **Read Only** but other times I can edit data in the results grid?

Data in the query results grid is only editable when the query results includes a primary key. For example, "SELECT type FROM food" will be read-only if "type" is not a primary key, but "SELECT id, type FROM food" will be editable when "id" is a primary key. Typically, "SELECT *" syntax is used in Workbench which often includes query results with a primary key.

For additional information, hover over the "Read Only" icon to reveal a tooltip that explains why your result set is in read-only mode.

A.2. I'm attempting to execute a DELETE query but the query fails with an "Error Code: 1175" error. How do I proceed?

By default, Workbench is configured to not execute DELETE or UPDATE queries that do not include a WHERE clause on a KEY column. To alter this behavior, open your Workbench **Preferences**, select the **SQL Editor** section, and disable the following preference:

[ ] "Safe Updates". Forbid UPDATEs and DELETEs with no key in WHERE clause or no LIMIT clause.

Changing this preference requires you to reconnect to your MySQL server before it can take affect.

A.3. My MySQL server connection is timing out with an error like "Error Code: 2013. Lost connection to MySQL server during query". Can I adjust the timeout?

Yes, go to **Preferences**, **SQL Editor**, and adjust the **DBMS connection read time out** option that defaults to 600 seconds. This sets the maximum amount of time (in seconds) that a query can take before MySQL Workbench disconnects from the MySQL server.

A.4. What do the column flag acronyms (PK, NN, UQ, BIN, UN, ZF, AI) in the MySQL Workbench Table Editor mean?

Checking these boxes will alter the table column by assigning the checked constraints to the designated columns.

Hover over an acronym to view a description, and see the Section 8.1.11.2, “The Columns Tab” and MySQL CREATE TABLE documentation for additional details.

Data Management

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A.3 How to export (save) a MySQL database to a text file? 417

A.1. How do I import comma-separated values (CSV) data into MySQL using Workbench?

Importing CSV data into a new or existing *table*: the **Table Data Import** wizard imports configurable CSV data into a new or existing table. This option was added in MySQL Workbench 6.3.

Importing CSV data into a *result set*: the **Import records from external file** wizard imports CSV data directly into a result set's view.

Alternatively, the **Data Import** wizard imports your saved MySQL files into your MySQL server. For additional information, see Section 6.5, “Data Export and Import”.

If you are importing Excel files, then consider using the official MySQL for Excel Add-on for Excel.

A.2. How do I export MySQL data to a plain text file with a format such as CSV, JSON, or XML?

The results view panel in Workbench has an "Export recordset to an external file" option that exports your result set to a wide variety of formats. For additional information, see Export a Result Set.

Note

This is different than the **Data Export** wizard that exports your MySQL data to standard MySQL formats. For additional information about that, see Section 6.5, “Data Export and Import”.

If you are exporting to Excel, then consider using the official MySQL for Excel Add-on for Excel.

A.3. How to export (save) a MySQL database to a text file?

Open a MySQL connection, and select Server from the main navigation menu and choose Data Export to open the data export wizard. Alternatively, choose **Data Export** from the left Management pane for the desired MySQL selection.

Here you can choose which databases to export, whether or not to include the data, dump to a single file or multiple files (one per table), and more. For additional details, see Section 6.5, “Data Export and Import”.

General

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A.1. I'm forced to use MySQL Workbench 5.2.x, is its documentation available?

Although the 5.2.x branch is no longer maintained, its documentation is archived at http://dev.mysql.com/doc/index-archive.html.

Appendix B Keyboard Shortcuts

The following tables list keyboard shortcuts for MySQL Workbench commands. **Modifier** in the tables stands for the platform-specific modifier key. This is **Command** on OS X, **Control** on other platforms. On OS X, the **Alt** key is **Option**.

There are keyboard shortcut tables for the File, Edit, View, Arrange, Model, Query, Database, Scripting, Help, and EER Diagram Mode menus.

File Menu

Table B.1 File menu keyboard shortcuts

Function	Keyboard Shortcut	Context
New Model	Modifier+N	All
Open Model	Modifier+O	All
Open SQL Script	Modifier+Shift+O	SQL Editor
Close Tab	Modifier+W, Modifier+F4 on Windows	All
Save Model	Modifier+S	Model
Save Script	Modifier+S	SQL Editor
Save Model As	Modifier+Shift+S	Model
Save Script As	Modifier+Shift+S	SQL Editor
Forward Engineer SQL CREATE Script	Modifier+Shift+G	Model
Forward Engineer SQL ALTER Script	Modifier+Alt+Y	Model
Synchronize With SQL CREATE Script	Modifier+Shift+Y	Model
Print	Modifier+P	EER Diagram mode only
Exit	Modifier+Q	All

Edit Menu

Table B.2 Edit menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Undo	Modifier+Z	Model, EER Diagram
Redo	Modifier+Y, Modifier+Shift+Z (OS X)	Model, EER Diagram
Cut	Modifier+X	All
Copy	Modifier+C	All
Paste	Modifier+V	All
Delete	Modifier+Delete, Command+BackSpace (OS X)	All
Edit Selected	Modifier+E	Model, EER Diagram
Edit Selected in New Window	Modifier+Shift+E	Model, EER Diagram
Select All	Modifier+A	EER Diagram

Function	Keyboard Shortcut	Context
Find	Modifier+F	All
Find Advanced	Modifier+Alt+F	All
Find Next	F3	All
Find Previous	Shift+F3	All
Search and Replace	Modifier+Shift+F	All
Comment/Uncomment lines of SQL	Modifier+/	SQL Editor
Auto-Complete SQL	Modifier+Space	SQL Editor

View Menu

Table B.3 View menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Output Window	Modifier+F2, Modifier+Option+2 (OS X)	All
Set Marker n	Modifier+Shift+n (n is integer 1..9)	EER Diagram
Go to Marker n	Modifier+n (n is integer 1..9)	EER Diagram

Arrange Menu

Table B.4 Arrange menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Bring to Front	Modifier+Shift+F	EER Diagram
Send to Back	Modifier+Shift+B	EER Diagram

Model Menu

Table B.5 Model menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Add Diagram	Modifier+T	Model, EER Diagram
Validate All	Modifier+Alt+V	Model, EER Diagram
Validate All (MySQL)	Modifier+Alt+B	Model, EER Diagram
Model Options	Command+Alt+, (Shortcut available only on OS X)	Model, EER Diagram

Query Menu

Table B.6 Query menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Execute statement	Modifier+Return	SQL Editor
Execute statements	Modifier+Shift+Return	SQL Editor
New Tab	Modifier+T	SQL Editor

Database Menu

Table B.7 Database menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Query Database	Modifier+U	All
Reverse Engineer	Modifier+R	Model, EER Diagram
Forward Engineer	Modifier+G	Model, EER Diagram
Synchronize Model	Modifier+Y	Model, EER Diagram

Scripting Menu

Table B.8 Scripting menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Scripting Shell	Modifier+F3, Modifier+Option+3 (on OS X)	All
Run Workbench Script File	Modifier+Shift+R	All

Help Menu

Table B.9 Help menu keyboard shortcuts

Function	Keyboard Shortcut	Context
Help Index	F1, Command+Option+question (on OS X)	All

EER Diagram Mode

In the EER Diagram view, a number of other keyboard shortcuts are available.

Table B.10 EER diagram mode keyboard shortcuts

Function	Keyboard Shortcut
Selection tool	Escape
Hand tool	H
Delete tool	D
Layer tool	L
Note tool	N
Image tool	I
Table tool	T
View tool	V
Routine Group tool	G
Non-Identifying Relationship 1:1	1
Non-Identifying Relationship 1:n	2
Identifying Relationship 1:1	3
Identifying Relationship 1:n	4
Identifying Relationship n:m	5
Relationship Using Existing Columns	6

Table B.11 Keyboard shortcut changes

MySQL Workbench version	The Change
5.2.45	The "Modifier+/" shortcut was added to comment/uncomment SQL in the SQL editor
5.2.45	On Microsoft Windows, the "Modifier+W" shortcut was changed to "Control+F4" -- this shortcut closes MySQL Workbench tabs

Appendix C Extending Workbench

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MySQL Workbench provides an extension and scripting system that enables the developer to extend MySQL Workbench capabilities. While the core of MySQL Workbench is developed using C++, it is possible to harness this core functionality using the Python scripting language. MySQL Workbench also provides access to a cross-platform GUI library, MForms, which enables the creation of extensions that feature a graphical user interface.

The extension system enables the following capabilities:

- Automate common tasks
- Extend the Workbench user-interface
- Create Tools/Plugins (code which can be invoked from the Workbench menu system)
- Manipulate schemata
- Create custom Workbench features

C.1 GRT and Workbench Data Organization

The GRT, or Generic RunTime, is the internal system used by Workbench to hold model document data. It is also the mechanism by which Workbench can interact with Modules and Plugins. Workbench model data, such as diagrams, schemata, and tables, is stored in a hierarchy of objects that can be accessed by any plugin. The information is represented using standard data types: integers, doubles, strings, dicts, lists, and objects.

The GRT can be accessed using the Python scripting language. Awareness is required of how the GRT data types map into Python. For example, the GRT integer, double, and string data types are seen as corresponding Python data types. Lists and dicts are kept in their internal representation, but can generally be treated as Python lists and dicts, and accessed in the usual way. Objects contain data fields and methods, but the GRT recognizes only objects from a pre-registered class hierarchy.

It is possible to fully examine the classes contained within the GRT using the Workbench Scripting Shell. Dots in class names are changed to underscores in their Python counterparts. For example, `db.mysql.Table` becomes `db_mysql_Table` in Python.

The Application Objects Tree (GRT Tree)

As mentioned previously, Workbench document data is stored in an object hierarchy. This hierarchy is known as the GRT Tree. The GRT Tree can be accessed and modified using Python or C++. Be careful

when modifying the GRT Tree as mistakes can lead to document corruption. Backups should be made before manipulating the tree. Read-only access to the tree is the safest approach, and is sufficient in most cases.

The main nodes in the Application Object Tree

Table C.1 The main nodes in the Application Object Tree

Node	Description
wb.registry	Application data such as plugin registry, list of editors, and options.
wb.customData	A generic dictionary for data you can use to store your own data. This dictionary is saved and reloaded with Workbench and is global (not document specific).
wb.options	Contains some default options that are used by Workbench.
wb.rdbmsMgmt	Internal registry of supported RDBMS modules, known data types.
wb.doc	The currently loaded model document.
wb.doc.physicalModels[0]	The currently loaded model object, containing the database catalog and diagrams.
wb.doc.physicalModels[0].catalog	The database catalog for the model. Contains the list of schemata.
wb.doc.physicalModels[0]catalog.schemata	List of schemata in the model. Individual schema can be accessed as a list: schemata[0], schemata[1] ...
wb.doc.physicalModels[0].catalog.schemata[0].tables (.views, .routines, ...)	Lists of tables, views, routines in the schema.
wb.doc.physicalModels[0].diagrams	List of EER diagrams in the model.
wb.doc.physicalModels[0].diagrams[0].figures (.layers, .connections, ...)	List of figures, layers, connections (relationships) in the diagram.

C.2 Modules

In the GRT Modules are libraries containing a list of functions that are exported for use by code in other modules, scripts, or Workbench itself. Modules can be written in C++ or Python, but the data types used for arguments and the return value must be GRT types.

GRT modules are similar to Python modules, but are imported from the built-in `grt` module, instead of directly from an external file. The list of modules loaded into the `grt` module is obtained from `grt.modules`. Modules can be imported in Python using statements such as `from grt.modules import WbModel`.

To export functions as a module from Python code, you must carry out the following steps:

1. The source file must be located in the user modules folder. This path is displayed in the Workbench Scripting Shell with the label **Looking for user plugins in...**. It is also possible to install the file using the main menu item Scripting, Install Plugin/Module File.

2. The source file name must have the extension `_grt.py`; for example, `my_module_grt.py`.

3. Some module metadata must be defined. This can be done using the `DefineModule` function from the wb module:

```
from wb import *
ModuleInfo = DefineModule(name='MyModule', author='Your Name', version='1.0')
```

4. Functions to be exported require their signature to be declared. This is achieved using the export decorator in the previously created ModuleInfo object:

```
@ModuleInfo.export(grt.INT, grt.STRING)
def checkString(s):
   ...
```

   For the `export` statement, the return type is listed first, followed by the input parameter types, specified as GRT typenames. The following typenames can be used:

   - `grt.INT`: An integer value. Also used for boolean values.
   - `grt.DOUBLE`: A floating-point numeric value.
   - `grt.STRING`: UTF-8 or ASCII string data.
   - `grt.DICT`: A key/value dictionary item. Keys must be strings.
   - `grt.LIST`: A list of other values. It is possible to specify the type of the contents as a tuple in the form `(grt.LIST, <type-or-class>)`. For example, (grt.LIST, grt.STRING) for a list of strings. For a list of table objects, the following would be specified: `(grt.LIST, grt.classes.db_table)`.
   - `grt.OBJECT`: An instance of a GRT object or a GRT class object, from `grt.classes`.

Note

These types are defined in the `grt` module, which must be imported before they are available for use.

The following code snippet illustrates declaring a module that exports a single function:

```
from wb import *
import grt

ModuleInfo = DefineModule(name='MyModule', author="your name", version='1.0')

@ModuleInfo.export(grt.DOUBLE, grt.STRING, (grt.LIST, grt.DOUBLE))
def printListSum(message, doubleList):
   sum = 0
   for d in doubleList:
      sum = sum + d
   print message, sum
   return sum
```

C.3 Plugins / Tools

Plugins are special Modules that are exposed to the user through the Workbench GUI. This is typically done using the main menu, or the context-sensitive menu. Much of the MySQL Workbench functionality is

implemented using plugins; for example, table, view, and routine editors are native C++ plugins, as are the forward and reverse engineering wizards. The Administrator facility in MySQL Workbench is implemented entirely as a plugin in Python.

A plugin can be a simple function that performs some action on an input, and ends without further interaction with the user. Examples of this include auto-arranging a diagram, or making batch changes to objects. To create a simple plugin, the function must be located in a module and declared as a plugin using the `plugin` decorator of the `ModuleInfo` object.

Plugins can have an indefinite runtime, such as when they are driven by the user through a graphical user interface. This is the case for the object editors and wizards within MySQL Workbench. Although the wizard type of plugin must be declared in the usual way, only the entry point of the plugin will need to be executed in the plugin function, as most of the additional functionality will be invoked as a result of the user interacting with the GUI.

Note

Reloading a plugin requires MySQL Workbench to be restarted.

Imported plugin files (and their compiled counterparts) are stored here:

Table C.2 User Plugin File Location

Operating System	File Path
Windows	%AppData%\MySQL\Workbench\modules
OS X	~username/Library/Application Support/MySQL/Workbench/modules
Linux	~username/.mysql/workbench/modules

Declare a plugin using this syntax:

```
@ModuleInfo.plugin(plugin_name, caption, [input], [groups], [pluginMenu])
```

These parameters are defined as follows:

- **plugin_name**: A unique name for the plugin. It may contain only alphanumeric characters, dots, and underscores.
- **caption**: A caption to use for the plugin in menus.
- **input**: An optional list of input arguments.
- **groups**: Optional list of groups the plugin belongs to. Recognized values are:
  - `Overview/Utility`: The Context menu in the Model Overview.
  - `Model/Utility`: The menu for diagram objects.
  - `Menu/<category>`: The Plugins menu in the main menu.
- **pluginMenu**: Optional name of a submenu in the Plugins menu where the plugin should appear. For example, Catalog, Objects, Utilities. This is equivalent to adding a `Menu/<category>` in the groups list.

C.4 Adding a GUI to a Plugin Using MForms

MySQL Workbench is implemented with a C++ core back-end, and a native front-end for each supported platform. Currently the front-end is implemented with Windows Forms on Microsoft Windows, GTK+ on

Linux, and Cocoa on OS X. This approach permits the application to have a native look and feel, while reducing the amount of work required to maintain the project. However, the GUI functionality required by MySQL Workbench can be met by a subset of graphical operations. These are implemented in a cross-platform GUI library, MForms. This further reduces the development effort because plugin developers can use MForms rather than writing front-end specific code for each supported platform. This also helps consistency of operation across all platforms. MForms is coded in C++, but provides a Python interface. To use it, the Python code must import the `mforms` module.

MForms Containers

Given the problems of using an absolute coordinate system across different platforms, MForms employs containers that perform automatic layout. The basic containers that MForms provides include:

- **Form**: A top-level window which can contain a single control, usually another container. The window will be sized automatically to fit its contents, but can also be sized statically.
- **Box**: This container can be filled with one or more controls in a vertical or horizontal layout. Each child control can be set to use either the minimum of required space, or fill the box in the direction of the layout. In the direction perpendicular to the layout, for example vertical in a horizontal layout, the smallest possible size that can accommodate all child controls will be employed. So, in this example, the smallest height possible to accommodate the controls would be used.
- **Table**: This container can organize one or more controls in a grid. The number of rows and columns in the table, and the location of controls within the grid, can be set by the developer.
- **ScrollView**: This container can contain a single child control, and adds scrollbars if the contents do not fit the available space.

C.5 The Workbench Scripting Shell

The Workbench Scripting Shell provides a means for entering and executing Python scripts. Through the use of the scripting shell, MySQL Workbench can support new behavior and data sources using code written in Python. The shell can also be used to explore the current Workbench GRT (Generic RunTime) facilities.

The scripting shell is not only useful for expanding MySQL Workbench. You can use a script file from the scripting shell command line to perform repetitive tasks programmatically.

Note

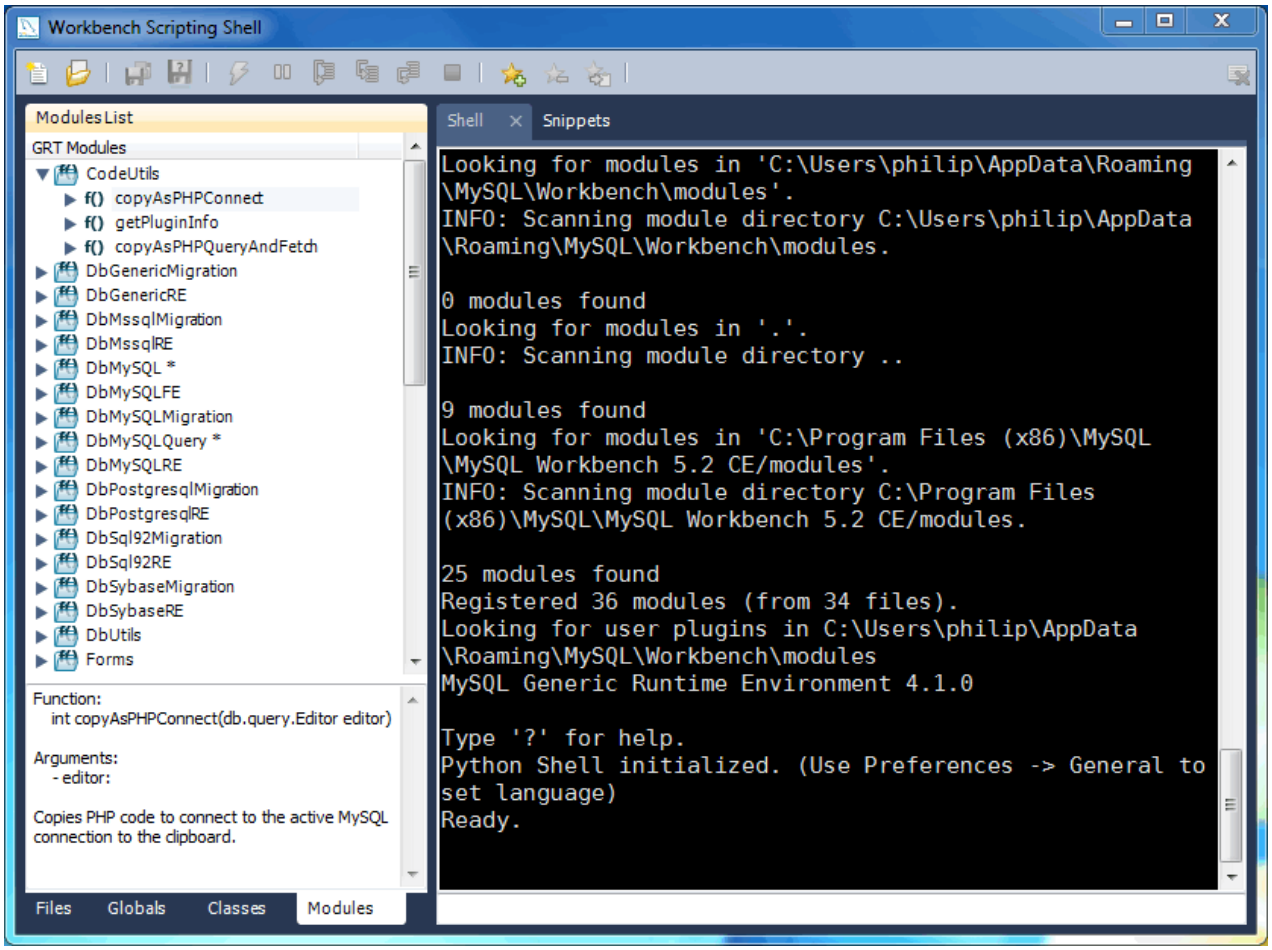
Although they serve a different purpose, the MySQL Utilities are also integrated with MySQL Workbench. For more information, see Appendix F, *MySQL Utilities*.

C.5.1 Exploring the Workbench Scripting Shell

To open the Workbench Scripting Shell, select Scripting, Scripting Shell from the main menu. You can also open the Workbench Scripting Shell using the **Control** + **F3** key combination on Windows and Linux, **Command** + **F3** on OS X, or by clicking the shell button above the EER diagram navigator. The Workbench Scripting Shell will then open in a new dialog.

The following screenshot shows the Workbench Scripting Shell dialog.

Figure C.1 The Workbench Scripting Shell

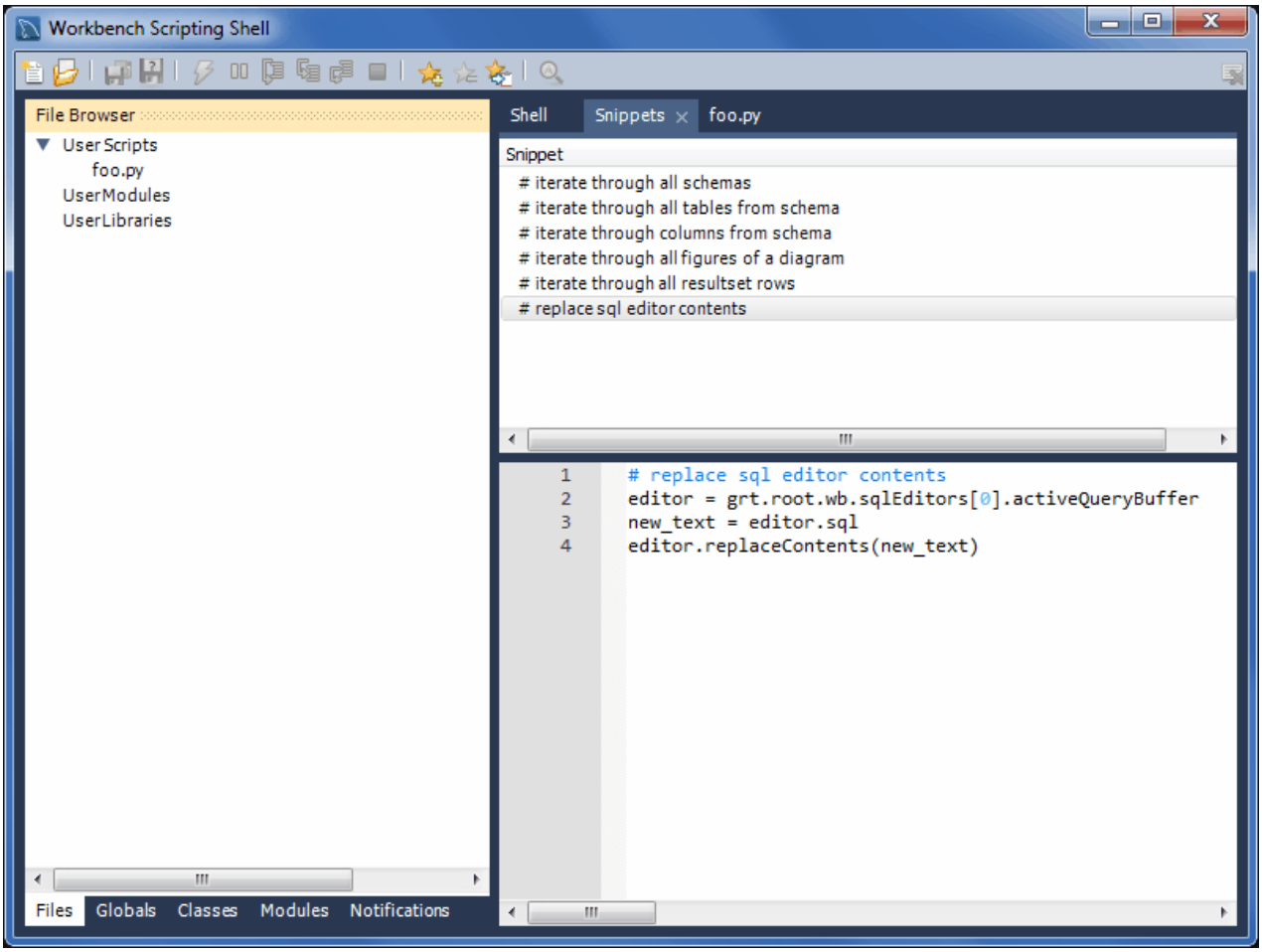


C.5.2 The Shell Window

The Workbench Scripting Shell is primarily used for running Python scripts, or directly typing commands in Python. However, you can also use it to access the Workbench Scripting Shell Scripting Library functions and global functions and objects. To see the available commands, type “?”. You can also cut and paste text to and from the shell window.

The **Snippets** tab is a scratch pad for saving code snippets. This makes it easy to reuse and execute code in MySQL Workbench.

Figure C.2 The Workbench Scripting Shell: Snippets



Opened script file tabs are to the right of the **Snippets** tab. Script tabs are labeled with the script's filename, or `Unnamed` for snippets without a name. You can cut-and-paste to and from the tabs, or right-click on a snippet to open a context menu with options to Execute Snippet, Send to Script Editor, or Copy To Clipboard.

While individual commands can be entered into the shell, it is also possible to run a longer script, stored in an external file, using the main menu item Scripting, Run Workbench Script File. When scripts are run outside of the shell, to see the output use the main menu item View, Output.

It is also possible to run script files directly from the shell. For details on running script files, type `? run` at the Workbench Scripting Shell prompt. The following message is displayed:

```
Help Topics
-----------
grt        General information about the Workbench runtime
scripting  Practical information when working on scripts and modules for Workbench
wbdata     Summary about Workbench model data organization
modules    Information about Workbench module usage
plugins    Information about writing Plugins and Modules for Workbench
Type '? [topic]' to get help on the topic.

Custom Python Modules
---------------------
```

```
   grt         Module to work with Workbench runtime (grt) objects
   grt.root    The root object in the internal Workbench object hierarchy
   grt.modules Location where Workbench modules are available
   grt.classes List of classes known to the GRT system
   mforms      A Module to access the cross-platform UI toolkit used in some Workbench features
   wb          Utility module for creating Workbench plugins

Type 'help(module/object/function)' to get information about a module, object or function.
Type 'dir(object)'                  to get a quick list of methods an object has.

For an introductory tutorial on the Python language,    visit http://docs.python.org/tutorial/
For general Python and library reference documentation, visit http://python.org/doc/
```

Within the Workbench Scripting Shell, there are five tabs on the top of the left side panel: **Files**, **Globals**, **Classes**, and **Modules**, and **Notifications**.

Note

An exception is thrown while attempting to use `input()` or read from `stdin`.

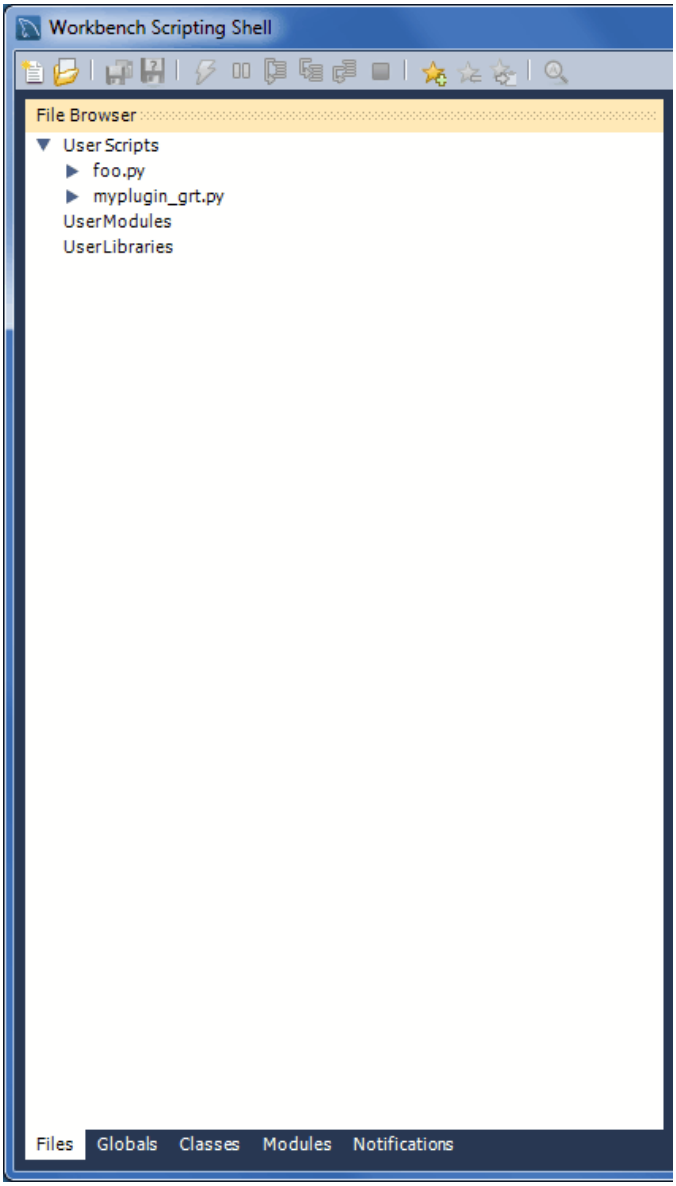
C.5.3 The Files, Globals, Classes, Modules, and Notifications Tabs

The Workbench Scripting Shell features the **Files**, **Globals**, **Classes**, **Modules**, and **Notifications** tabs, in addition to the main **Shell** tab.

The Files Tab

Lists folders and files for user-defined (custom) script files. The categories are **User Scripts**, **User Modules**, and **User Libraries**.

Figure C.3 The Workbench Scripting Shell tab: Files



By default, scripts are stored in the `scripts/` folder of your MySQL Workbench configuration folder. These default locations are:

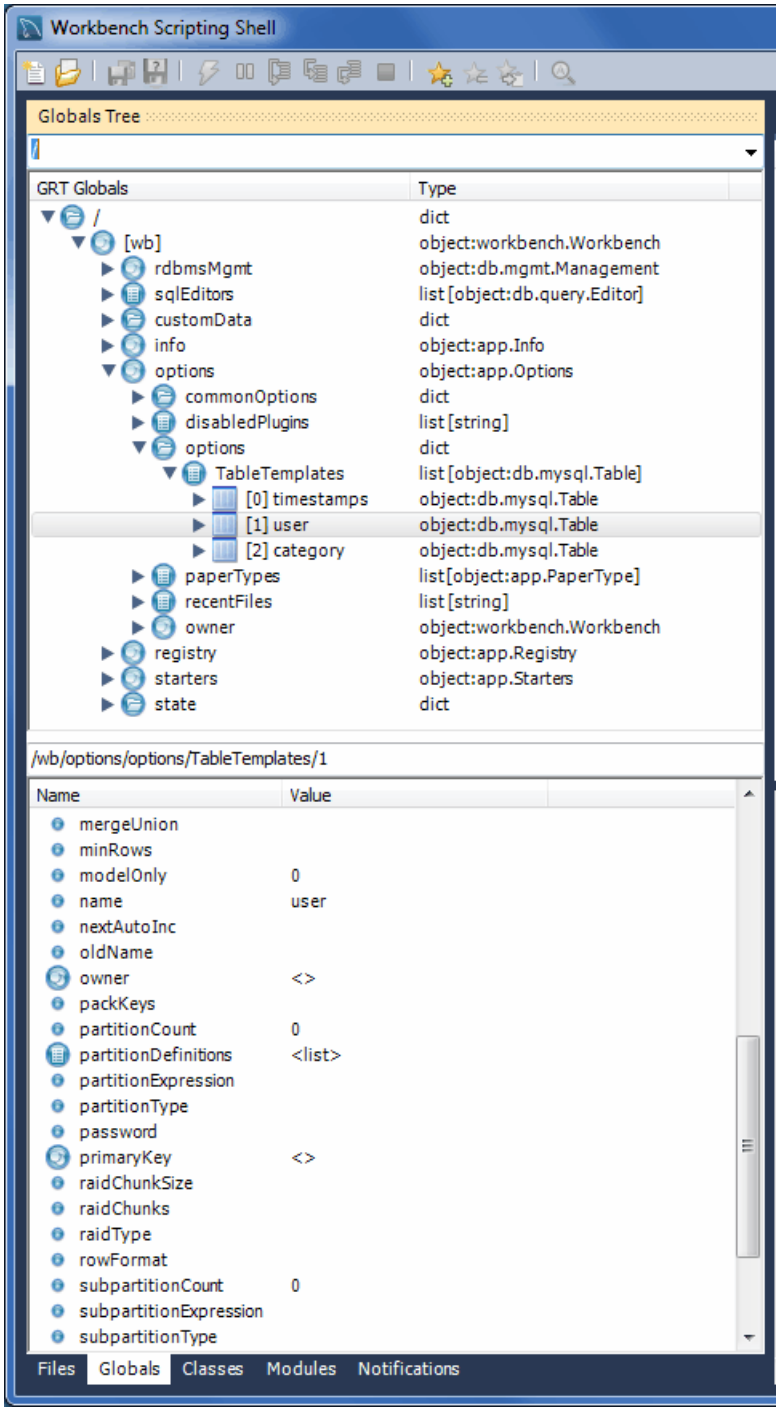
Table C.3 Default Scripts Location

Operating System	Default `scripts/` path
Linux	`~/.mysql/workbench/scripts`
OS X	`~/Library/Application\ Support/MySQL/Workbench/scripts/`
Windows 7	`C:\Users\[user]\AppData\Roaming\MySQL\Workbench\scripts\`

The Globals Tab

At the top of the window is a list that is used to select the starting point, or root, of the GRT Globals tree displayed beneath it. By default, this starting point is the root of the tree, that is, '/'. You can expand or collapse the GRT Globals tree as desired. The GRT Globals tree is the structure in which MySQL Workbench stores document data. Clicking any item results in its name and value being displayed in the panel below the tree.

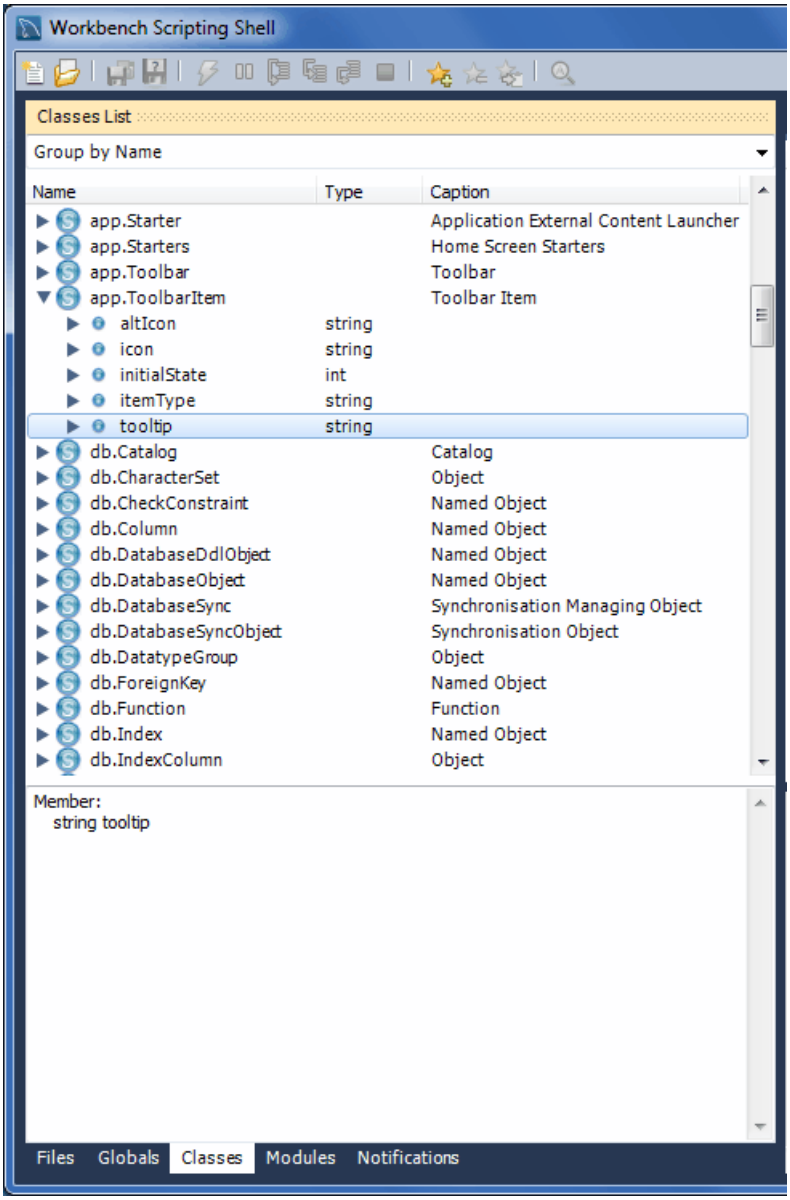
Figure C.4 The Workbench Scripting Shell tab: Globals



The Classes Tab

A `class` is a user-defined data type formed by combining primitive data types: integers, doubles, strings, dicts, lists, and objects. This tab shows the definitions of the classes used by the objects in the **Modules** tab. Clicking a class causes a brief description of the class to be displayed in a panel below the classes explorer.

Figure C.5 The Workbench Scripting Shell tab: Classes



When the **Classes** tab is selected, the list displays the following items:

- **Group by Name**: Group by the object name
- **Group by Hierarchy**: Group by inheritance
- **Group by Package**: Group by functionality

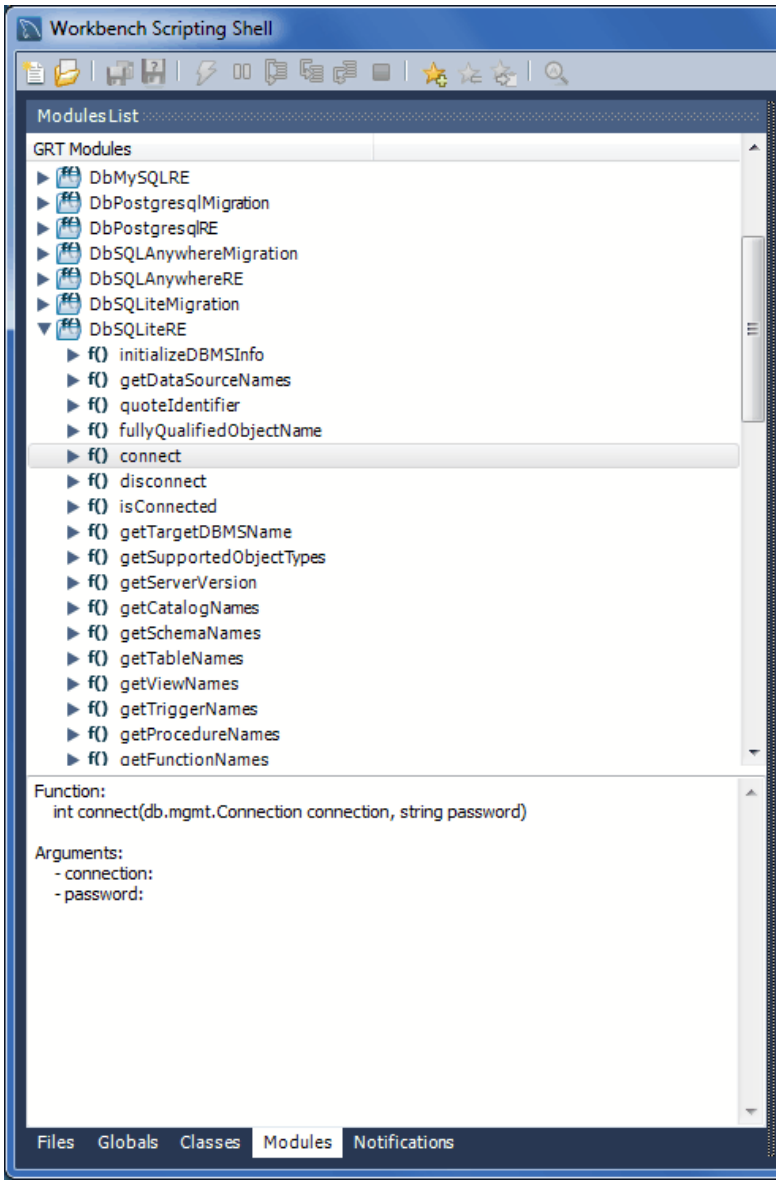
The default view for this tab is **Group By Name**. This view shows all the different objects arranged alphabetically. Click the + icon or double-click a package to show the properties of the struct.

If you switch to the hierarchical view, you will see `GrtObject`: the parent object from which all other objects are derived.

The Modules Tab

The **Modules** tab enables you to browse the MySQL Workbench installed modules and their functions. Clicking a module within the explorer causes its details to be displayed in a panel below the explorer. This facility is useful for exploring the available modules, and their supported functions. It is also a way to check whether custom modules have been correctly installed.

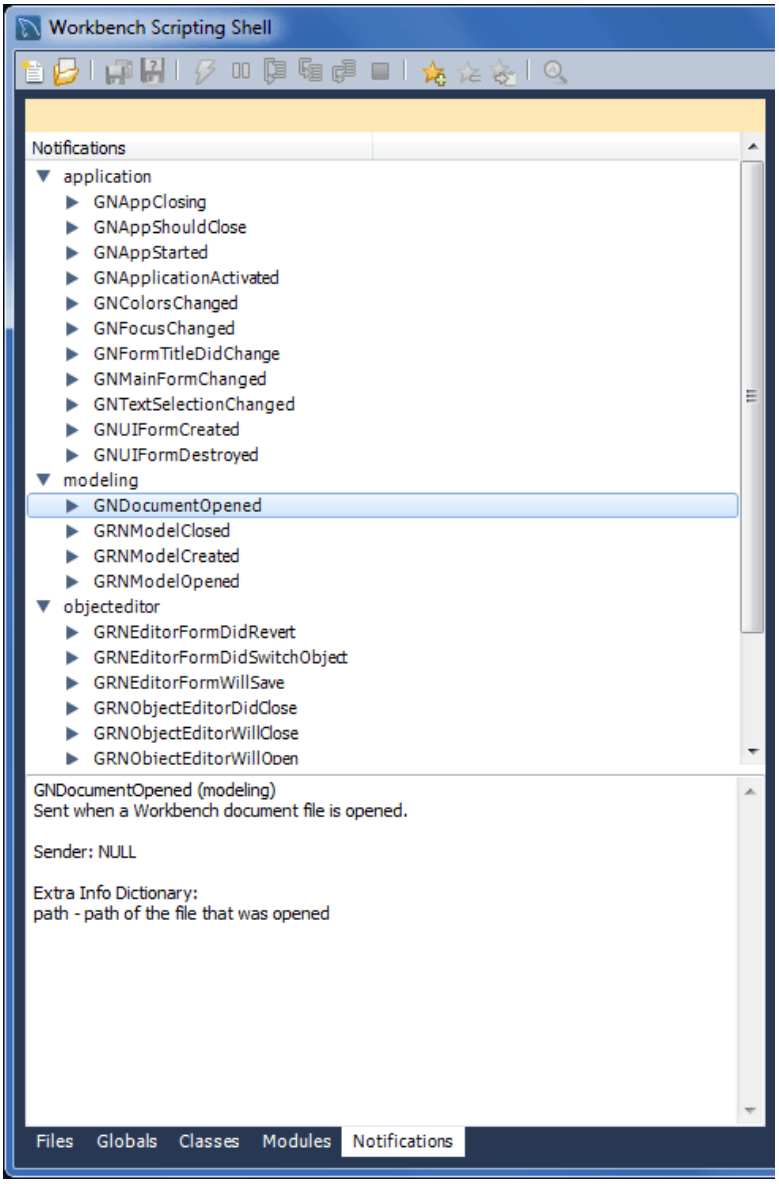
Figure C.6 The Workbench Scripting Shell tab: Modules



The Notifications Tab

The set of `notification` classes used by MySQL Workbench modules. Click a notification class for a description of its use.

Figure C.7 The Workbench Scripting Shell tab: Notifications



C.6 Tutorial: Writing Plugins

This tutorial shows you how to extend MySQL Workbench by creating a plugin.

The Sample Plugin

EER Diagrams are useful for visualizing complex database schemata. They are often created for existing databases, to clarify their purpose or document them. MySQL Workbench provides facilities for reverse engineering existing databases, and then creating an EER Diagram automatically. In this case, relationship lines between foreign keys in the table will automatically be drawn. This graphical representation makes the relationships between the tables much easier to understand. However, one of the most popular storage engines for MySQL, MyISAM, does not include support for foreign keys. This means that MyISAM tables that are reverse engineered will not automatically have the relationship lines drawn between tables, making the database harder to understand. The plugin created in this tutorial gets around this problem by using the

fact that a naming convention is often used for foreign keys: `tablename_primarykeyname`. Using this convention, foreign keys can automatically be created after a database is reverse engineered, which will result in relationship lines being drawn in the EER diagram.

Algorithm

The basic algorithm for this task would be as follows:

```
for each table in the schema
   for each column in the table
      look for another table whose name and primary key name match the current column name
      if such a table is found, add a foreign key referencing it
```

As iterating the complete table list to find a match can be slow for models with a large number of tables, it is necessary to optimize by pre-computing all possible foreign key names in a given schema.

```
import grt

def auto_create_fks(schema):
   fk_name_format = "%(table)s_%(pk)s"
   possible_fks = {}
   # create the list of possible foreign keys from the list of tables
   for table in schema.tables:
      if table.primaryKey:
         format_args = {'table':table.name, 'pk':table.primaryKey.name}
         fkname = fk_name_format % format_args
         possible_fks[fkname] = table

   # go through all tables in schema, this time to find columns that may be a fk
   for table in schema.tables:
      for column in table.columns:
         if possible_fks.has_key(column.name):
            ref_table = possible_fks[column.name]
            if ref_table.primaryKey.formattedType != column.type:
               continue
            fk = table.createForeignKey(column.name+"_fk")
            fk.referencedTable = ref_table
            fk.columns.append(column)
            fk.referencedColumn.append(ref_table.primaryKey)
            print "Created foreign key %s from %s.%s to %s.%s" \
            % (fk.name, table.name, column.name, ref_table.name, ref_table.primaryKey.name)

auto_create_fks(grt.root.wb.doc.physicalModels[0].catalog.schemata[0])
```

Creating a Plugin from a Script

To create a plugin from an arbitrary script, it is first necessary to make the file a module, and export the required function from it. It is then necessary to declare the module as a plugin, and specify the return type and input arguments.

```
from wb import *
import grt

ModuleInfo = DefineModule(name="AutoFK", author="John Doe", version="1.0")

@ModuleInfo.plugin("sample.createGuessedForeignKeys",
  caption="Create Foreign Keys from ColumnNames",
  input=[wbinputs.objectOfClass("db.mysql.schema")],
  groups=["Overview/Utility"])

@ModuleInfo.export(grt.INT, grt.classes.db_mysql_Schema)
def auto_create_fks(schema):
```

```
...
```

With the addition of the preceding code, the `auto_create_fks()` function is exported and will be added to the schema context menu in the model overview. When invoked, it receives the currently selected schema as its input.

Appendix D How To Report Bugs or Problems

The following is a list of tips and information that is helpful for reporting a MySQL Workbench bug.

A useful bug report includes:

- The exact steps taken to repeat the bug, ideally as a video if the bug is tricky to repeat
- A screenshot, if the bug is visual
- The error messages, which includes text sent to stdout and the GUI
- The MySQL Workbench Log file

  The log file location can be found using Help, Locate Log Files from within MySQL Workbench.

Bugs that cannot be reproduced are difficult and nearly impossible to fix, so it is important to provide the steps necessary to reproduce the bug.

Where to report a bug

Visit http://bugs.mysql.com/ and use one of the "MySQL Workbench" bug categories.

Log Levels

There are six different log levels, with increasing levels of verbosity: `error`, `warning`, `info`, `debug1`, `debug2`, and `debug3`. By default, the `error`, `warning` and `info` levels are enabled. There is also a "none" level that disables logging.

Important

Please enable the `debug3` level before generating a log for the report.

The enabled error log levels can be configured using an environment variable, or by using a command line parameter.

Both the environment variable and command line variants accept a single error level, but enabling a more verbose option will implicitly enable the levels below it. For example, passing in "info" will also enable the "error" and "warning" levels.

- Environment variable: `WB_LOG_LEVEL`

  Command line option: `--log-level` on OS X and Linux, and `-log-level` on Microsoft Windows

Note

If both the command line and environment variable are set, the command line takes precedence.

For example:

```
# Microsoft Windows
shell> cd "C:\Program Files (x86)\MySQL\MySQL Workbench CE 6.3.5\"
shell> MySQLWorkbench.exe -log-level=debug3
```

```
# OS X
shell> cd /Applications
shell> MySQLWorkbench --log-level=debug3

# Linux (Ubuntu)
shell> cd /usr/bin
shell> mysqlworkbench --log-level=debug3
```

If the `info` level is enabled, the system information and all paths used in the application are also logged. On Microsoft Windows, this also means that the log file contains the full set of current environment variables that are active for the program.

Operating System Specific Notes

Microsoft Windows

- Log file location: Near the user's app data folder, such as `C:\Users\[user]\AppData\Roaming\MySQL\Workbench\log` for Microsoft Windows 7.
- In case of errors (or exceptions), the log file contains the stack trace to the point MySQL Workbench can track it (usually only C# code, and not C++ code). Also, all warnings are added to the log if the warning (or greater) log level is enabled.
- If it is a crash and that cannot be replicated by the MySQL Workbench team, and the stack trace cannot be obtained, we will request a crashdump. Instructions for enabling a crashdump can be found here, and please also read the MSDN details for this as we need a full dump, and not the mini dump.
- For crashes related to display issues, start MySQL Workbench with the `-swrendering` parameter (and only then, as it switches off OpenGL rendering, which is of no use in WBA or WQE). This output will be added to the log file.
- If it is a crash when MySQL Workbench is started (especially if the error report includes something about `kernelbase.dll`), we will ask you to run `depends.exe` on the `MySQLWorkbench.exe` binary, and ask for the reported errors.
- If it is a crash when MySQL Workbench is started, and it is a 64-bit version of Microsoft Windows, check that the correct MSVC runtimes are installed. Often people install the 64-bit version of them, but only the 32-bit will function. More precisely: `MSVC 2010 runtime x86 (32-bit)`.

OS X

- Log File Location: `~/Library/Application Support/MySQL/Workbench/logs`
- System crash logs generated for Workbench are in `~/Library/Logs/DiagnosticReports/MySQLWorkbench*`

Linux

- Log File Location: `~/.mysql/workbench/logs`
- For a crash, we might ask for a stack trace that can generated by `gdb` by using the following steps:

Note

Because published MySQL Workbench builds lack debug symbols, this step is optional and will probably not be necessary.

    - In shell, execute `source /usr/bin/mysql-workbench`
    - Quit MySQL Workbench
    - In shell, execute `gdb /usr/bin/mysql-workbench-bin`
    - In the gdb interface, type `run`
    - In MySQL Workbench, repeat the crash
    - In the gdb interface, type `bt`
- If it is a crash, also run `glxinfo`. If that also crashes, then it is a driver/X server problem related to OpenGL that is not specific to MySQL Workbench.

Appendix E MySQL Enterprise Features

A MySQL Enterprise subscription is the most comprehensive offering of MySQL database software, services and support; it ensures that your business achieves the highest levels of reliability, security, and uptime.

An Enterprise Subscription includes a MySQL Workbench GUI for the following enterprise features:

- The MySQL Enterprise server: The most reliable, secure, and up-to-date version of the world's most popular open source database
- MySQL Enterprise Backup: Performs backup and restore operations for MySQL data, and MySQL Workbench offers a GUI for these operations
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For more information, visit http://www.mysql.com/enterprise

Appendix F MySQL Utilities

MySQL Utilities is a package of utilities that are used for maintenance and administration of MySQL servers. These utilities encapsulate a set of primitive commands, and bundles them so they can be used to perform macro operations with a single command. They can be installed via MySQL Workbench, or as a standalone package.

They are a set of command-line utilities and a Python library for making the common tasks easy to accomplish. The library is written entirely in Python, meaning that it is not necessary to have any other tools or libraries installed to make it work. It is currently designed to work with Python v2.6 or later and there is no support (yet) for Python v3.1.

The utilities are available under the GPLv2 license, and are extendable using the supplied library.

For more information, see the MySQL Utilities manual at http://dev.mysql.com/doc/index-utils-fabric.html.

Installing The MySQL Utilities

MySQL Utilities development is managed elsewhere, and require a separate download. Attempting to start the MySQL Utilities when they are not installed will prompt for a download and their installation. See the MySQL Utilities manual for additional information.

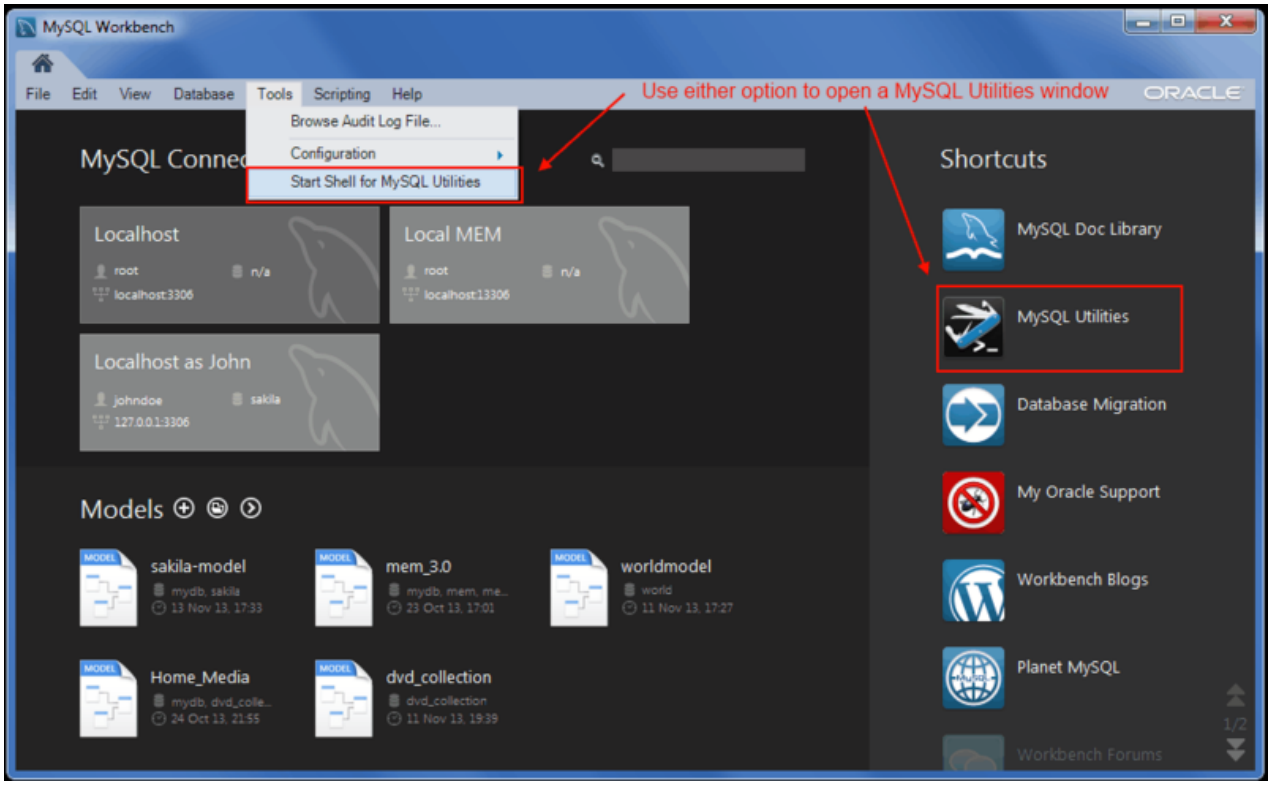
Note

MySQL Workbench searches for the `mysqluc` MySQL Utility in the system's `PATH` to determine if the MySQL Utilities are installed.

Opening MySQL Utilities From MySQL Workbench

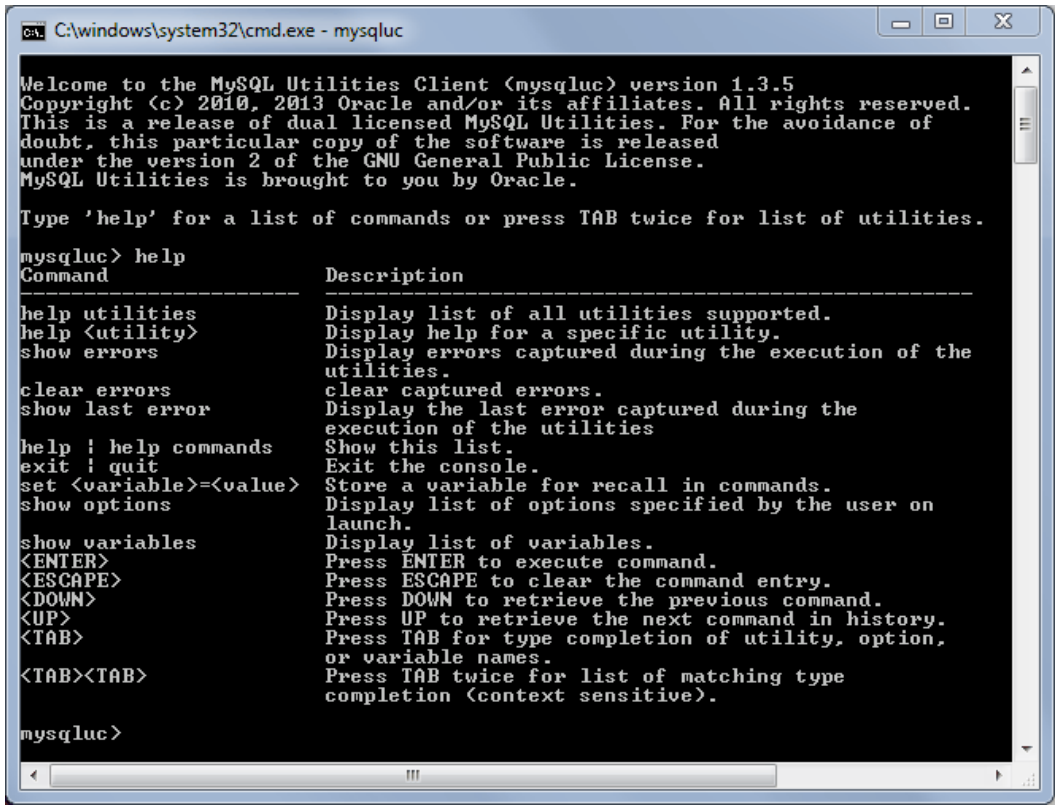
Open the MySQL Utility `mysqluc` (MySQL Utilities Unified Console) from MySQL Workbench from either the Tools menu, or from the MySQL Utilities shortcut on the Home page.

Figure F.1 Open MySQL Utilities From Workbench



The MySQL Utilities console window can be seen below, with the "help" command executed:

Figure F.2 The MySQL Utilities Console


C:\windows\system32\cmd.exe - mysqluc
Welcome to the MySQL Utilities Client (mysqluc) version 1.3.5
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doubt, this particular copy of the software is released
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MySQL Utilities is brought to you by Oracle.
Type 'help' for a list of commands or press TAB twice for list of utilities.
mysqluc> help
Command Description
help utilities Display list of all utilities supported.
help <utility> Display help for a specific utility.
show errors Display errors captured during the execution of the utilities.
clear errors clear captured errors.
show last error Display the last error captured during the execution of the utilities
help ¦ help commands Show this list.
exit ¦ quit Exit the console.
set <variable>=<value> Store a variable for recall in commands.
show options Display list of options specified by the user on launch.
show variables Display list of variables.
<ENTER> Press ENTER to execute command.
<ESCAPE> Press ESCAPE to clear the command entry.
<DOWN> Press DOWN to retrieve the previous command.
<UP> Press UP to retrieve the next command in history.
<TAB> Press TAB for type completion of utility, option, or variable names.
<TAB><TAB> Press TAB twice for list of matching type completion (context sensitive).
mysqluc>

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gdal/frmts/hdf4/hdf-eos/*
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gdal/frmts/pcraster/libcsf
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Python was created in the early 1990s by Guido van Rossum at Stichting
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In 1995, Guido continued his work on Python at the Corporation for
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in Reston, Virginia where he released several versions of the
software.

In May 2000, Guido and the Python core development team moved to
BeOpen.com to form the BeOpen PythonLabs team.  In October of the same
```

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year, the PythonLabs team moved to Digital Creations (now Zope
Corporation, see http://www.zope.com).  In 2001, the Python Software
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    Release         Derived     Year        Owner       GPL-
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    0.9.0 thru 1.2              1991-1995   CWI         yes
    1.3 thru 1.5.2  1.2         1995-1999   CNRI        yes
    1.6             1.5.2       2000        CNRI        no
    2.0             1.6         2000        BeOpen.com  no
    1.6.1           1.6         2001        CNRI        yes (2)
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    2.1.2           2.1.1       2002        PSF         yes
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A C-program for MT19937, with initialization improved 2002/1/26.
Coded by Takuji Nishimura and Makoto Matsumoto.

Before using, initialize the state by using init_genrand(seed)
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Any feedback is very welcome.
http://www.math.keio.ac.jp/matumoto/emt.html
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Sockets
=======
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L. Peter Deutsch
ghost@aladdin.com

Independent implementation of MD5 (RFC 1321).

This code implements the MD5 Algorithm defined in RFC 1321, whose
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The original and principal author of md5.h is L. Peter Deutsch
<ghost@aladdin.com>.  Other authors are noted in the change history
that follows (in reverse chronological order):

2002-04-13 lpd Removed support for non-ANSI compilers; removed
      references to Ghostscript; clarified derivation from RFC 1321;
      now handles byte order either statically or dynamically.
1999-11-04 lpd Edited comments slightly for automatic TOC extraction.
1999-10-18 lpd Fixed typo in header comment (ansi2knr rather than md5);
      added conditionalization for C++ compilation from Martin
      Purschke <purschke@bnl.gov>.
1999-05-03 lpd Original version.

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Modified by Jack Jansen, CWI, July 1995:
- Use binascii module to do the actual line-by-line conversion
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- Arguments more compliant with Python standard

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